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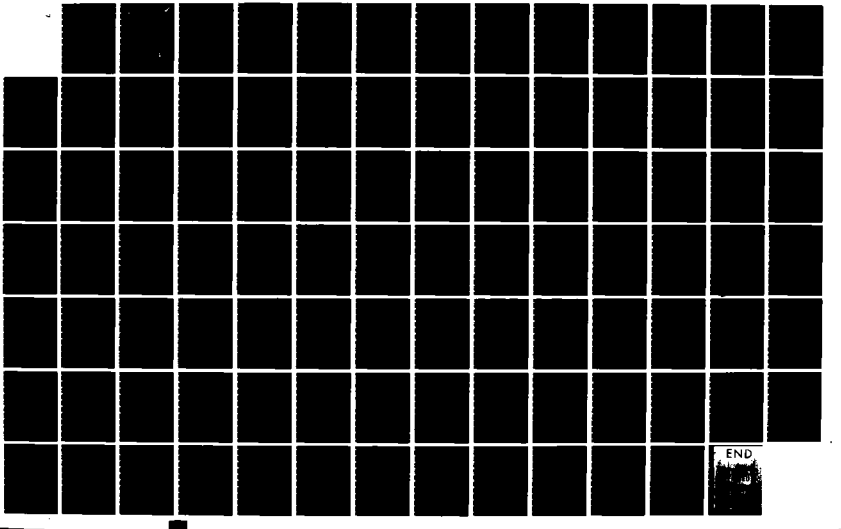

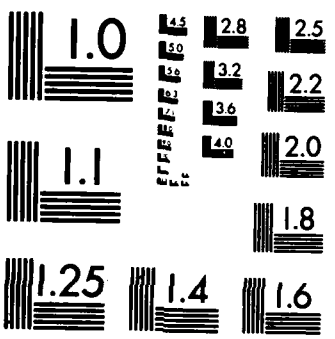

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Automated En Route Air Traffic Control Algorithmic Specifications

DATA SPECIFICATION

Volume 5

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16. Abstract

This Algorithmic Specification establishes the design criteria for four air traffic automation software functions to be included in the initial software package of the Advanced Automation System (AAS). The need for each function is discussed within the context of the existing National Airspace System (NAS). A top-down definition of each function is provided with descriptions on increasingly more detailed levels. The final, most detailed description of each function identifies the data flows and transformations taking place within each function.

This document consists of five volumes. Volume 5, Data Specification, contains the definitions of important data constructs used across all the algorithmic specifications. The data are accumulated in a modified relational data base.

The other four volumes of this specification provide design criteria for the following:

- o Volume 1, Trajectory Estimation
- o Volume 2, Airspace Probe
- o Volume 3, Flight Plan Conflict Probe
- o Volume 4, Sector Workload Probe

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1. INTRODUCTION

1.1 Purpose

This volume supports the AERA 1.01 algorithmic specifications in Volumes 1-4 of this report. The Data Specification documents all common data used by the Trajectory Estimation, Airspace Probe, Sector Workload Probe and Flight Plan Conflict Probe Specifications. Data names referenced in these documents are described in detail, and the relationships among the data are specified. This document is not intended to be a complete description of all data required by an Advanced Automation System (AAS). Local data used in deriving the results of these functions are not included; only data which are shared between algorithmic functions are included.

It is intended that the Data Specification be general enough to be applicable to any software implementation and flexible enough to be easily expanded as further algorithmic specifications are developed. The data are organized in a natural, intuitive manner, aggregated into functionally related categories, and presented in an application-independent manner. The data are discussed in the context of existing National Airspace System (NAS) En Route Automation terminology where possible. In cases where existing terminology is insufficient for identifying data, new terminology is introduced rather than attempting to extend or redefine NAS terminology.

This document is not intended to be a design for the data base in the AAS, since the development of that design is the responsibility of the AAS contractor.

1.2 Organization of Document

A relational data model is used in this specification to describe the AERA 1.01 data. An overview of this model and the rationale behind its selection are contained in Section 2. Section 3 presents the AERA data model organized into four functional categories: Environmental Data, Real-Time Data, Planning Data, and System Parameters. The data are defined and the relations among the data are specified. Appendix A contains a brief description of normalization procedures for a relational model. Appendix B contains an alphabetical list of the data elements in each table. Appendix C contains a cross reference between data elements and tables. Appendix D contains an index of table types. Appendix E lists references.

1.3 Practical Orientation

This data model is based on the practical needs of the first AERA 1.01 functional specifications, and does not strictly reflect all the design goals of a relational model described in Section 2. The data model will be refined during further development stages of the AERA Specifications.

2. DATA MODEL AND DESCRIPTION

2.1 Goals of the Data Model

The following guidelines were used when choosing a method to represent the AERA 1.01 data:

- The model must describe the data used in the four functions included in AERA 1.01.
- The data must be presented in a simple, logical and intuitive manner.
- References must not be made (or implied) to storage, implementation, or design techniques.
- The data descriptions must aid the algorithmic development of the AERA 1.01 functions.

To meet these guidelines, a relational data model was chosen.

2.2 The Relational Model

A relational data model describes data in terms of relationships among the data and uses no devices or structures for definition. To illustrate what this means, it is useful to show other types of models which do rely on underlying structure (such as a hierarchy or a network) to define data. Consider a simple model:

```
STATE occurs 50 times;
   COUNTY (descendant of STATE) occurs 100 times;
        CITY (descendant of COUNTY) occurs 300 times;
```

When this model is represented in a hierarchical form, it appears as in Figure 2-1. To determine the value of CITY, it is first necessary to know which occurrence of COUNTY has been selected; in order to know this, the selected STATE must be known. The value of any item depends as much on the item's location in the hierarchy as on its definition. In fact, the location of an item is part of its definition.

A network, or plex model, permits more than one parent for any child, so that many-to-many relationships are easily represented. The disadvantage of this method is that pointers and chains are inherently a part of the model (see Figure 2-2).

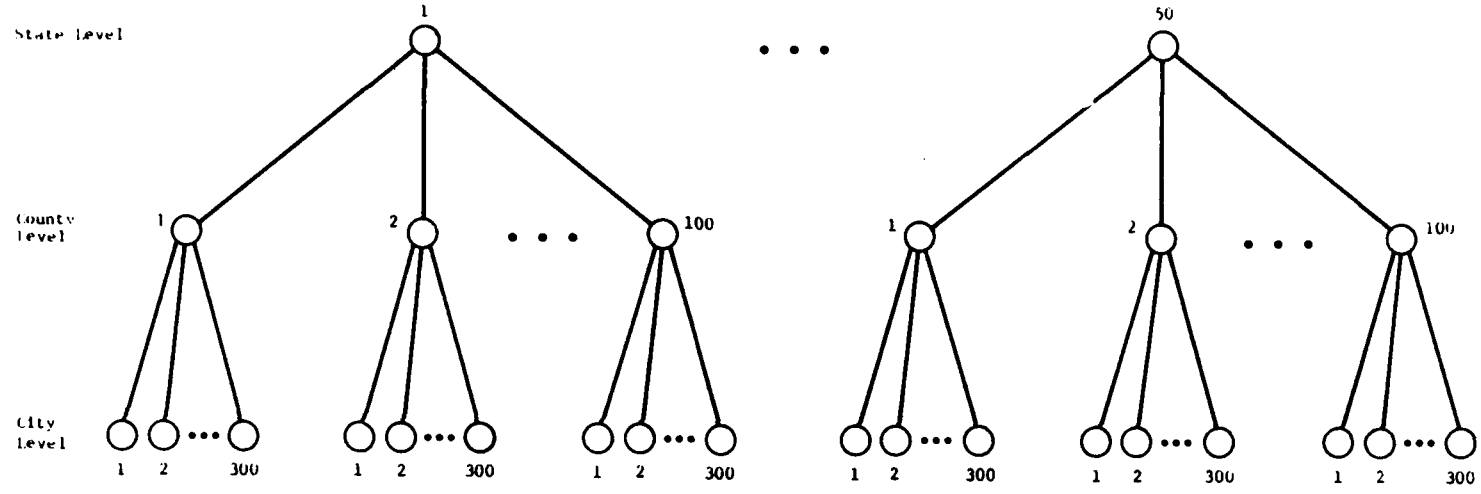


FIGURE 2-1
THE STATES MODEL IN HIERARCHICAL FORM

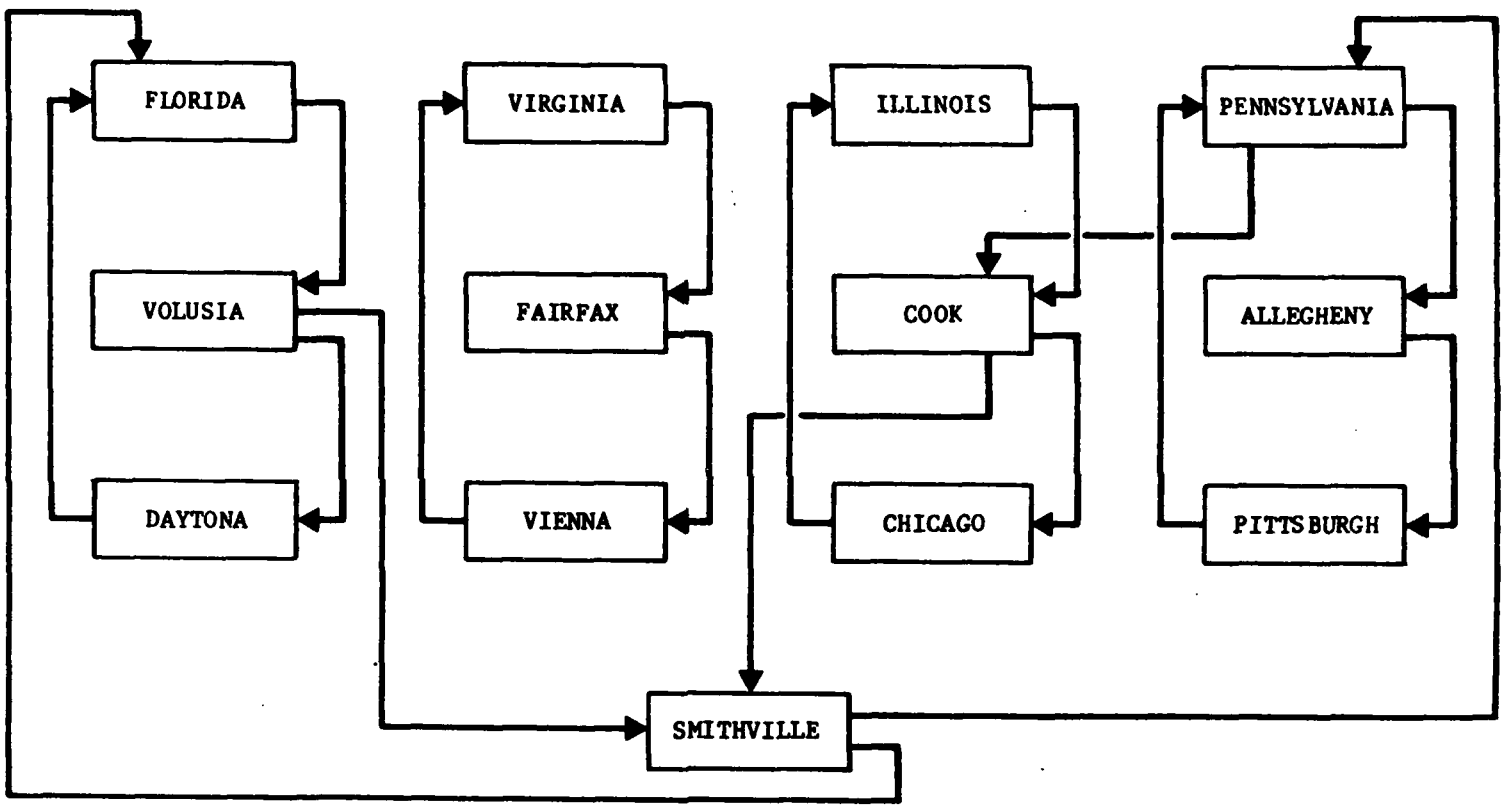


FIGURE 2-2
THE STATES MODEL IN NETWORK (PLEX) FORM

The same data presented in a relational model is a two-dimensional table which contains all meaningful combinations of STATE, COUNTY and CITY:

STATE	COUNTY	CITY
Florida	Volusia	Daytona Beach
Virginia	Fairfax	Vienna
Illinois	Cook	Chicago
Florida	Volusia	Smithville
.	.	.
Pennsylvania	Allegheny	Pittsburgh
Pennsylvania	Cook	Smithville

This relation is represented by a named "table," perhaps the STATES table, which is simply depicted:

STATE	COUNTY	CITY

This notation removes references (real or implied) to structures and pointers. It is a convenient way to think of the data, and it does not influence data base design or implementation methods.

2.3 Normalization, Key to the Relational Model

Normalization is a step-by-step process to reduce complex data relationships to two-dimensional tabular forms characteristic of a relational model.

Normalization principles have been formalized into five rules. Each rule reduces a data relation to a normalized form. First normal form is the lowest level of normalization, fifth is the highest. Any relation in fifth normal form is also in first, second, third and fourth normal forms.

The normalized model has the advantages that redundancy of data is reduced by grouping related data elements, and the resulting structures are simple, easy to understand. Appendix A gives a brief description of the normalization rules.

2.4 Methods

The data in Section 3 were defined as follows:

- The AERA testbed data base was examined for tables which contain data describing the four functions to be included in AERA 1.01. Items depending on a particular testbed implementation were deleted or modified.

- The tables were condensed to contain only global data; data local to a particular task or function were not included in the model. Data shared between functions, however, were included.

- Descriptions of data not included in the current AERA data base were taken from the AERA 1.01 specifications. Deletions and changes were also made.

- The information was reduced to normalized form using normalization rules 1 through 3 (Appendix A). Since the model is a practical representation of the AERA 1.01 algorithmic specifications, normal rules 4 and 5 were not always enforced because of the rigid requirements they sometimes placed on algorithm design.

2.5 Terminology and Use

Certain terms used often in this paper have precise definitions:

- FIELD

  The smallest unit of data in a table is a field. (Also called a data item.) (See Figure 2-3)

- RECORD

  A group of related fields of information treated as a unit. (See Figure 2-3)

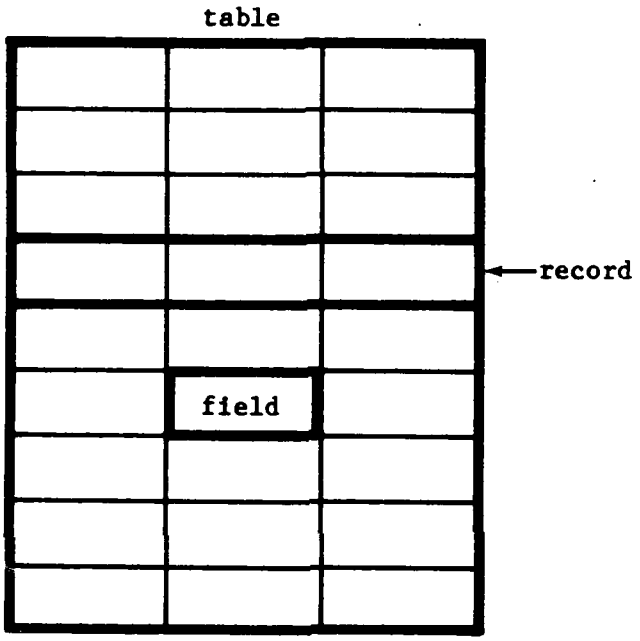


FIGURE 2-3
THE RELATIONAL STRUCTURES

- TABLE

  A named aggregate of records, all of which have the same field types. Tables contain all the records for a defined relation. (See Figure 2-3)

- KEY

  One or more fields which uniquely identify a record in a table. Key fields can not be null.

- PARAMETER

  A data item which has a constant value, and is identifiable by its name alone.

- NORMALIZED FORM

  A data description which has been reduced to a simpler representation by use of normalization rules.

- FIELD TYPE

  A *field type* is the name given to a column of a table. A field type may have a modifier (such as min_ or max_) which helps to distinguish fields of the same type (such as min_altitude, max_altitude, min_speed, max_speed, etc.).

Capitalized names denote a field that is part of the key, so that the table to describe the route of an aircraft looks as follows:

FL_ID	ALONG_ROUTE_DISTANCE	x	y

Each table described in Section 3 refers to a collective set of data. To refer to the whole set, the table name is used. To refer to one field, the fully qualified name is used, which is the table name and the field type separated with a period. For instance, when working with the current position of an aircraft one would refer to the "AIRCRAFT_TRACKED_POSITION" table, and "AIRCRAFT_TRACKED_POSITION.x" would refer to all the x fields of the table (a column).

Although a key uniquely identifies a single record, groups of records may be located on other criteria. For instance, in the above table, FL_ID will uniquely identify a single record in the table. In algorithms referencing this table, however, the key does not have to be used to locate a record. All of the following are legitimate requests:

- "find all unique routes"
- "find all routes where x = a and y = b"
- "find all routes where along_route_distance = 100"

The key is generally only of importance when defining tables and putting them into normalized form. The key must uniquely identify a record: entries with duplicate keys are not permitted. Neither are null values permitted in key fields.

2.6 Naming Conventions

Fields have identifiable types which are cross-referenced in Appendix C to the tables in which they occur. Examples of field types are "altitude," "distance," "name," and "id." Wherever one of these field types occurs, the last word of the field name is always the type. Modifiers (such as "min" and "max," "beg" and "end") are given to further describe the field.

When referenced in the program design language (see Appendix E of Volumes 1-3 or Appendix C in Volume 4) or text, table names are always in full capital letters; field types are always in all lower case letters. Parameters (in Section 3.4) have the first character capitalized but all other characters lower case. Words in names are separated with an underscore. In the table definitions only, the field types of the key are capitalized.

Examples

Tables	WINDS, FLIGHT_PLANS
Fields	fix_names, volume_id
Parameters	Density_Coefficient, Conflict_Count

A distinction is made in the tables between a "name" and an "id." A name is an alphanumeric identifier which is known to the outside world, such as J41 (an airway) or DCA (a fix); an id may be thought of as an identifier to be used as a pointer into another table. Ids have value only as an identifier into a table, and may be thought of as a computer-assigned code.

2.7 Aggregates

Some combinations of fields are standard, and can be referred to by aggregate names. The most common aggregates are listed below.

Aggregate Name	Combined Fields
coordinate	x, y
position	x, y, z
cusp	x, y, z, time
velocity-vector	velocity_x, velocity_y, velocity_z

Where aggregates exist, they are defined with the table, both pictorially and in the text by means of the keyword AGGREGATE. These groupings may be retrieved from the model either in the aggregate form or as individual fields.

2.8 Global Tables and Parameters

The data defined in this document are global data. Global data include the following:

- Data which is shared among functions. For instance, the TRAJECTORIES table is shared between the Trajectory Estimation function and the Flight Plan Conflict Probe function.

- Data which is input to the functions from the outside world, such as data entered through the Man-Machine Interface or adaptation of the environmental data base.

- Data which is output from the functions to the outside world, such as results of conflict probes or any information to be displayed.

3. THE DATA MODEL

The relational model for AERA 1.01 is described by a set of tables which fall into four categories:

Environmental Data
Real-Time Data
Planning Data
System Parameters

3.1 Environmental Data

The AERA planning regions are geographical areas, each corresponding to an existing Air Route Traffic Control Center (ARTCC) or a future Area Control Facility (ACF). There are twenty ARTCCs (centers) in the continental United States. Each AERA region will contain a center's airspace and extend the center boundary slightly so that incoming and outgoing traffic can be seen even when it is not in the center's airspace.

Each center controls an airspace bounded by a polygon which stretches vertically from the ground to 60,000 feet. Each of the center airspaces is also divided into areas, which are in turn divided into sectors. Areas and sectors are also polygons with floors and ceilings. Area airspace extends upward from the ground or a specified altitude to 60,000 feet. Sectors may be stacked on top of each other in shelf-type arrangements which can vary during different traffic pattern hours, especially around large airports.

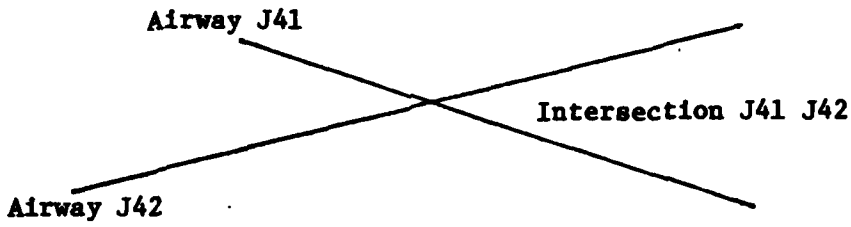
Each planning region also contains environmental obstructions of the airspace for which a minimum altitude for clearance is maintained in the data base. These are En route Minimum Safe Altitude Warnings (EMSAWs). EMSAWs are defined in the data base as polygons that have the ground as floor and their altitude as ceiling. They include mountains, large buildings, and towers.

Airways are named routes, where "route" is the generic term for a path which an aircraft traverses over the surface of the earth. Airways are defined as a series of fixes and airway intersections. A fix is a named, geographical point used for navigation and identified on navigational maps.

Other environmental data defined in this data model are special use airspaces and intersecting airways. Special use airspaces are volumes of airspace which aircraft may not enter at certain times. They include six types: alert area, controlled firing

area, military operations area, prohibited area, restricted area, and warning area. A special use airspace contains a start and stop time as part of its definition, since the space may not be restricted all of the time.

Intersecting airways are defined as the geographical points where airways intersect, and are referenced in pilot filed flight plans by juxtaposing the two airway names in a route string, e.g., "J41 J42" (see drawing below).



All of these environmental features are described in the data base. The tables contained in environmental data are the following:

- AIRWAYS
- SECTORS
- SECTOR_SHELVES
- SPECIAL_USE_AIRSPACES
- E_MSAW_AREAS
- VOLUME_COORDINATES
- VOLUMES
- ADAPTED_FIXES

AIRWAYS:

AIRWAY_NAME	VERTEX_NUMBER	fix_name

The airways table lists the fixes in a named, adapted route.

AIRWAY_NAME	Name of the adapted route, such as J41 (J denotes a high-altitude route) or V307 (V denotes a low-altitude route).
VERTEX_NUMBER	The number of the vertex in the airway. The fix_name identifies the point coordinates.
fix_name	The name of a fix that identifies a vertex in the airway.

SECTORS:

SECTOR_NUMBER	sector_name	center_name	volume_id

This table describes the sectors within the center.

SECTOR_NUMBER	The number of a sector.
sector_name	The name of the sector.
center_name	The name of the ARTCC that controls the sector.
volume_id	ID of the volume which describes the sector boundaries.

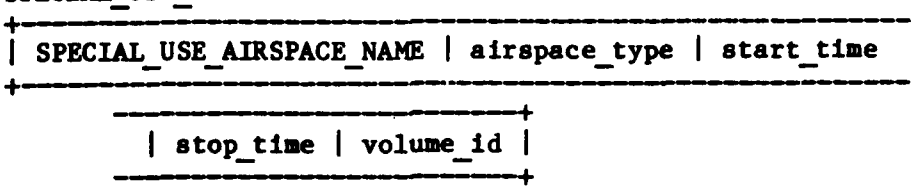
SECTOR_SHELVES:

SECTOR_NUMBER	SHELF_NAME	volume_id

This table defines the shelves within a sector.

SECTOR_NUMBER	The number of a sector.
SHELF_NAME	The name of a shelf within the sector.
volume_id	The ID of the volume which defines the shelf boundary.

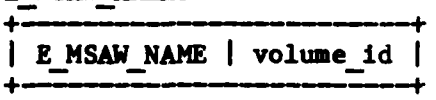
SPECIAL_USE_AIRSPACES:



This table relates a special use airspace name to information about the airspace. Special use airspaces are defined to be alert areas, military operations areas, prohibited areas, restricted areas, or warning areas.

SPECIAL_USE_AIRSPACE_NAME	Name of a special use airspace.
airspace_type	The type of special use airspace: alert, military operation, prohibited area, restricted area, or warning area.
start_time	Time when the area becomes restricted.
stop_time	Time when the area ceases to be restricted.
volume_id	Identifier of a volume which defines the boundaries of the special use airspace.

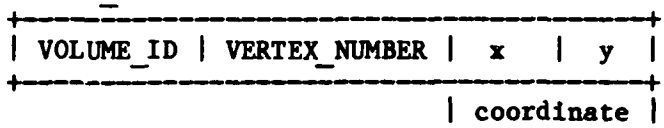
E_MSAW_AREAS:



This table defines an En Route Minimum Safe Altitude Warning area in the planning region.

E_MSAW_NAME	Name of an E-MSAW area.
volume_id	A volume which defines the boundaries of the E-MSAW area.

VOLUME_COORDINATES:



This table contains the vertex coordinates of each volume. An entry exists for each vertex of every volume, where a volume is an E-MSAW area, a sector, a shelf, or a special use airspace.

VOLUME_ID A volume identifier.

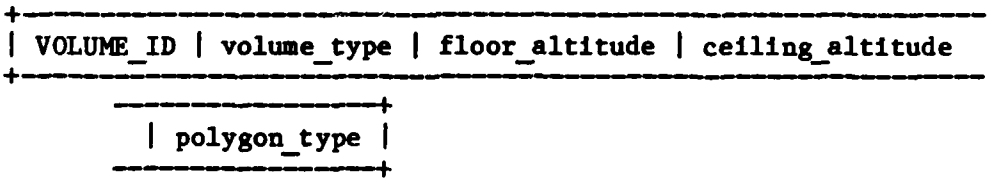
VERTEX_NUMBER A number assigned to each vertex in counting order.

x The x coordinate of the vertex defined by this entry.

y The y coordinate of the vertex defined by this entry.

coordinate AGGREGATE (x,y).

VOLUMES:



This table defines the minimum and maximum altitudes of a volume, the polygon type of the volume, and the volume type. One entry exists for each adapted volume.

VOLUME_ID A volume identifier.

volume_type Type of the volume: E-MSAW, sector, shelf, or special use airspace.

floor_altitude Minimum altitude of the volume.

ceiling_altitude Maximum altitude of the volume.

polygon_type The type of the polygon: either convex or concave.

ADAPTED_FIXES:

FIX_NAME	fix_type	x	y
		coordinate	

This table defines a named fix, including its type and location.

FIX_NAME	A name of an identified geographical point (a fix).
fix_type	The type of the fix. May be vor, vortac, beacon, airport, waypoint, or airway-airway intersection.
x	The value of x at the geographical point.
y	The value of y at the geographical point.
coordinate	AGGREGATE (x,y).

3.2 Real-Time Data

The tables in this section are updated often and describe data within the planning region which are dynamic in nature. The following tables are included:

- CURRENT_TIME
- WINDS
- AIRCRAFT_TRACKED_POSITION
- AIRCRAFT_CURRENT_CLEARANCE

CURRENT_TIME:

time	date

This table gives the current time and date.

time	Current time of the day.
date	Current day, month, and year.

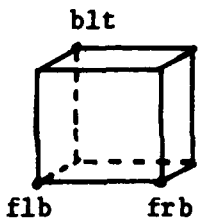
WINDS:

WIND_CELL_ID	flb_x	flb_y	flb_z	frb_x	frb_y	frb_z
	flb_coordinate			frb_coordinate		

blt_x	blt_y	blt_z	time	temperature
blt_coordinate				

direction	speed

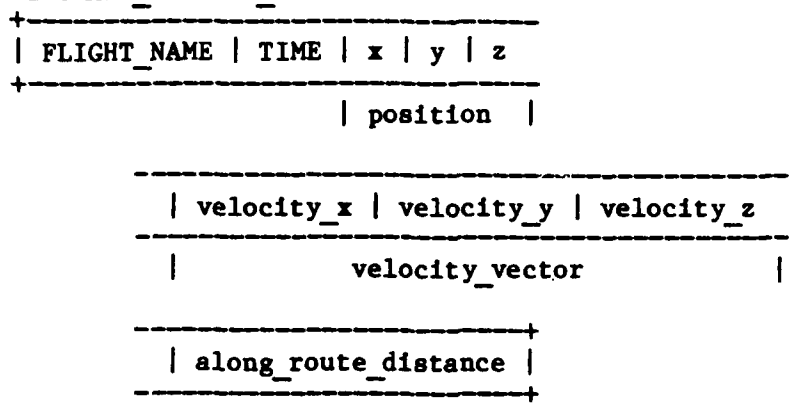
This table defines the coordinates of a wind cell and describes the most current wind conditions within the cell. Each cell is defined by three points: the front left bottom, the front right bottom, and the back left top. Wind information is updated every six hours.



WIND_CELL_ID	A wind cell identifier.
flb_x	The x value of the front left bottom corner.
flb_y	The y value of the front left bottom corner.
flb_z	The z value of the front left bottom corner.
frb_x	The x value of the front right bottom corner.
frb_y	The y value of the front right bottom corner.
frb_z	The z value of the front right bottom corner.
blt_x	The x value of the back left top corner.
blt_y	The y value of the back left top corner.

blt_z	The z value of the back left top corner.
time	The time this wind cell information was last updated.
temperature	Temperature within the wind cell.
direction	Prevailing direction of the winds within the wind cell.
speed	Prevailing speed of the winds within the wind cell.

AIRCRAFT_TRACKED_POSITION:



This table gives the current tracked position and along route distance of each aircraft. Several entries exist for each aircraft because a history of tracked position is maintained.

FLIGHT_NAME	Aircraft identification, for instance EA195.
TIME	Time at the recorded position.
x	The x component of the recorded position.
y	The y component of the recorded position.
z	The z component of the recorded position.
velocity_x	The x component of the vector at the recorded position.
velocity_y	The y component of the vector at the recorded position.
velocity_z	The z component of the vector at the recorded position.
along_route_ distance	The along route distance at the recorded position. This is a projection of aircraft position onto the converted route.
position	AGGREGATE (x,y,z).
velocity_vector	AGGREGATE (velocity_x, velocity_y, velocity_ z).

AIRCRAFT_CURRENT_CLEARANCE:

FLIGHT_NAME	altitude	speed

This table gives the current clearance altitude and speed for an aircraft.

FLIGHT_NAME	Aircraft identification, for instance EA195.
altitude	Altitude assigned by the current clearance.
speed	Speed assigned by the current clearance.

3.3 Planning Data

3.3.1 Aircraft Characteristics

These tables describe the flight characteristics of each aircraft in the planning region. The characteristics may come from several sources:

1. Global values which are supplied by the aircraft manufacturers.

2. Information supplied by the airlines, which incorporates their guidelines and operating procedures.

3. Information supplied by the pilot, which will probably be more specific than either of the previous sources.

These data may come from a combination of tne above sources, but will always be available in this standard form.

Speed and acceleration characteristics are broken into six tables to make maintenance of the tables more manageable. For example, speed characteristics have a double key, FLIGHT-ID and ALTITUDE, because the speed relationships are dependent on both of these fields. If a combined min/max, long-range-cruise, and maximum-endurance speeds table were used, there would be "holes" or null fields in some tables where a field did not have a value at a certain altitude. This might happen because a manufacturer supplied long-range-cruise statistics at different altitudes than min/max speed characteristics. The aircraft characteristics have been broken down into the smallest possible tables, in conformance to fourth and fifth normal forms.

AIRCRAFT_MIN_MAX_SPEED:

SOURCE	ALTITUDE	min_speed	max_speed

This table gives the minimum and maximum indicated air speeds (IAS) at an associated altitude for an aircraft type.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

ALTITUDE — The altitude for which the minimum and maximum speeds are stated.

min_speed — Minimum speed at the associated altitude.

max_speed — Maximum speed at the associated altitude.

AIRCRAFT_LRC_SPEED:

SOURCE	ALTITUDE	speed

The long-range cruise (LRC) speed relation gives the most operationally efficient use (in terms of fuel and flight time) cruise speeds in true air speed (TAS) at associated altitudes.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

ALTITUDE — An altitude which corresponds to a long-range cruise speed.

speed — Long-range cruise speed. Speed which provides the most efficient use of fuel and flight time, given in true air speed at associated altitude.

AIRCRAFT_MAX_ENDURANCE_SPEED:

SOURCE	ALTITUDE	speed

This table defines maximum endurance speeds (MES) for a range of altitudes for an aircraft type.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

ALTITUDE — An altitude corresponding to MES speed.

speed — Maximum endurance speed.

AIRCRAFT_ACCELERATION:

SOURCE	ALTITUDE	acceleration

This table gives the normal acceleration rate of an aircraft at cruising speed and at an associated altitude.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

ALTITUDE — An altitude which has a corresponding acceleration rate.

acceleration — The normal acceleration rate when at cruising speed, measured in true air speed (TAS), at the associated altitude.

CLIMB_MACH_TO_GRADIENT:

SOURCE	BEG_ALTITUDE	SPEED	GRADIENT	end_altitude	gradient_type

This table associates mach climb speeds with gradients at various altitudes for specific aircraft. An entry exists only at altitudes where a Mach speed indicator is applicable. Another table, CLIMB_IAS_TO_GRADIENT, gives the IAS gradient ratios at altitudes where IAS indication is reasonable. There will be some overlap of altitudes.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

BEG_ALTITUDE — An altitude which represents the beginning of a climb segment.

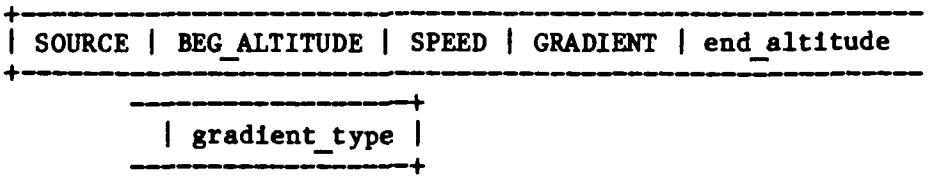
SPEED — A speed, expressed as Mach.

GRADIENT — The climb gradient associated with the given altitude interval and speed.

end_altitude — The top of the linear climb segment.

gradient_type — Either preferred, steeper than normal, or shallower than normal.

CLIMB_IAS_TO_GRADIENT:



This table associates climb indicated air speed (IAS) with gradients at various altitudes for specific aircraft. An entry exists only at altitudes where an IAS speed indicator is applicable. Another table, CLIMB_MACH_TO_GRADIENT, gives the Mach gradient ratios at altitudes where MACH indication is reasonable. There will be some overlap of altitudes.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

BEG_ALTITUDE — An altitude which represents the beginning of a climb segment.

SPEED — A speed, expressed as Mach.

GRADIENT — The climb gradient associated with the given altitude interval and speed.

end_altitude — The top of the linear climb segment.

gradient_type — Either preferred, steeper than normal, or shallower than normal.

DESCENT_MACH_TO_GRADIENT:

SOURCE	BEG_ALTITUDE	SPEED	GRADIENT	end_altitude	gradient_type

This table associates mach descent speeds with gradients at various altitudes for specific aircraft. An entry exists only at altitudes where an Mach speed indicator is applicable. Another table, DESCENT_IAS_TO_GRADIENT, gives the IAS gradient ratios at altitudes where IAS indication is reasonable. There will be some overlap of altitudes.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

BEG_ALTITUDE — An altitude which represents the beginning of a climb segment.

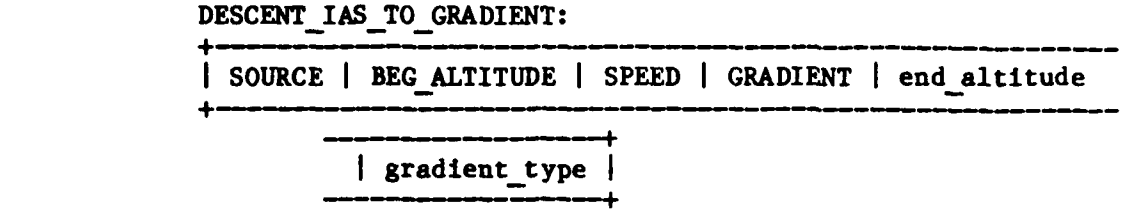
SPEED — A speed, expressed as Mach.

GRADIENT — The climb gradient associated with the given altitude interval and speed.

end_altitude — The top of the linear climb segment.

gradient_type — Either preferred, steeper than normal, or shallower than normal.

DESCENT_IAS_TO_GRADIENT:



This table associates descent indicated air speed (IAS) with gradients at various altitudes for specific aircraft. An entry exists only at altitudes where an IAS speed indicator is applicable. Another table, DESCENT_MACH_TO_GRADIENT, gives the Mach gradient ratios at altitudes where Mach indication is reasonable. There will be some overlap of altitudes.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

BEG_ALTITUDE — An altitude which represents the beginning of a climb segment.

SPEED — A speed, expressed as indicated air speed.

GRADIENT — The climb gradient associated with the given altitude interval and speed.

end_altitude — The top of the linear climb segment.

gradient_type — Either preferred, steeper than normal, or shallower than normal.

NOMINAL_CLIMB_SPEEDS

SOURCE	mach	ias

The nominal Mach and IAS climb speeds for an aircraft.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

mach — The nominal Mach climb speed.

ias — The nominal IAS climb speed.

NOMINAL_DESCENT_SPEEDS

SOURCE	mach	ias

The nominal Mach and IAS descent speeds for an aircraft.

SOURCE — This field contains the source of the information. It must be one of three possible values:

- a flight name, for flight specific information provided by the pilot
- a combination of airline and aircraft type, for airline supplied guidelines
- aircraft type, for information supplied by the manufacturer

mach — The nominal Mach descent speed.

ias — The nominal IAS descent speed.

3.3.2 Trajectory Data

These data describe the filed and planned trajectories for each aircraft in the planning region, and represent a hierarchy of flight plan representations:

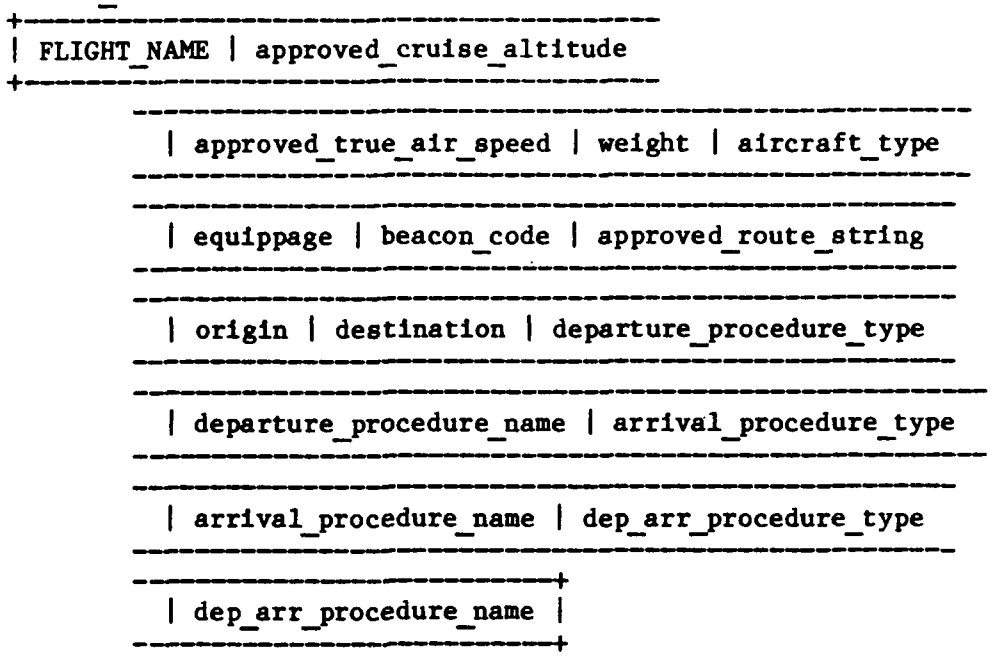
1. The approved flight plan, as filed by the pilot (prefiled), and approved and perhaps modified by the controller, gives the beginning and ending points of his flight along with a list of fixes that describe the horizontal path of the flight, and the intended cruise altitude and air speed.

2. The routes, a two-dimensional plan derived from the flight plan, lists the coordinates that occur along the horizontal route of the filed flight plan.

3. The TRAJECTORY is a four-dimensional adapted representation of the flight plan which is used for modeling. Trajectories are composed of cusps, or points in (x,y,z,t) space.

More than one planned flight path (FL_ID) may exist for any aircraft. The current FL_ID is one which is currently being used by AERA. A temporary FL_ID is one which is being formulated or tested by the system or controller in case of a reroute for a more direct route, collision avoidance, environmental conflict, or other reason. Temporary FL_IDs are transitory unless "made current," when the current FL_ID is replaced with the new FL_ID, and all other temporary plans disappear.

The Routes and Trajectory tables are keyed by FL_ID, because there may be more than one planned flight path per aircraft.



This table contains information about the intended route of the flight and the aircraft's unique characteristics.

FLIGHT_NAME	Name of a flight, for instance EA732.
approved_cruise_altitude	Intended cruise altitude of the flight.
approved_true_air_speed	Intended true air speed of the flight.
weight	Gross weight of the aircraft at takeoff.
aircraft_type	Manufacturer identification of the aircraft, for instance, B747, L1011, etc.
equippage	The aircraft's radar transponder DME or RNAV capability. One of the following: X No transponder T Transponder with no altitude encoding capability U Transponder with altitude encoding capability D DME, no transponder

	B DME, transponder with no altitude encoding capability A DME, transponder with altitude encoding capability M TACAN only, no transponder N TACAN only, transponder with no altitude encoding capability P TACAN only, transponder with altitude encoding capability C RNAV, transponder with no altitude encoding capability F RNAV, transponder with altitude encoding capability W RNAV, and no transponder S Digital data link
beacon_code	Transponder beacon code or ATC radio beacon as assigned by the controlling facility.
approved_center_route_string	The route of the aircraft as a list of fix names, lat/long coordinates, fix radial distances, and airways, for that portion which is relevant to the planning region.
origin	The fix name of the origination airport.
destination	The fix name of the destination airport.
departure_procedure_type	The type of departure procedure appended to the flight, if any: SID Standard Instrument Departure PDR Preferred Departure Route
departure_procedure_name	The name of the departure procedure employed, e.g., Calverton 6.
arrival_procedure_type	The type of arrival procedure appended to the flight, if any: STAR Standard Terminal Arrival Route PAR Preferred Arrival Route
arrival_procedure_name	The name of the arrival procedure.

dep_arr_procedure_type — The type of combined departure/arrival procedure appended to the flight, if any.
- PDAR Preferred Departure Arrival Route
- NULL No preferred Arrival Route

dep_arr_procedure_name — The name of the combined departure/arrival employed.

FLIGHT_ID_ASSOCIATIONS:

FL_ID	flight_name	fl_id_type

This table identifies the flight plans that exist.

FL_ID — A planned path for an aircraft.

flight_name — Identifier of the flight, e.g., PA342.

fl_id_type — Type of the flight path; either current or temporary.

ROUTES:

FL_ID	ALONG_ROUTE_DISTANCE	x	y
		coordinate	

This table lists the x,y pairs that describe the horizontal (two-dimensional) path of the flight, as derived from the flight plan route string.

FL_ID	A planned path for an aircraft.
ALONG_ROUTE_ DISTANCE	The distance from beginning of the path to the point defined by this entry.
x	The x component of the coordinate of the point.
y	The y component of the coordinate of the point.
coordinate	AGGREGATE (x,y).

TRAJECTORIES:

FL_ID	TIME	x	y	z	ground_speed	cusp_type
		cusp				

This table contains the cusps (x, y, z, t points) that describe the four-dimensional path of a flight. The trajectory is derived from the route (the two-dimensional x,y path of the flight)..

FL_ID — A planned path for an aircraft.

TIME — Time at the point described by the x,y,z fields.

x — The x value of the cusp.

y — The y value of the cusp.

z — THe z value of the cusp.

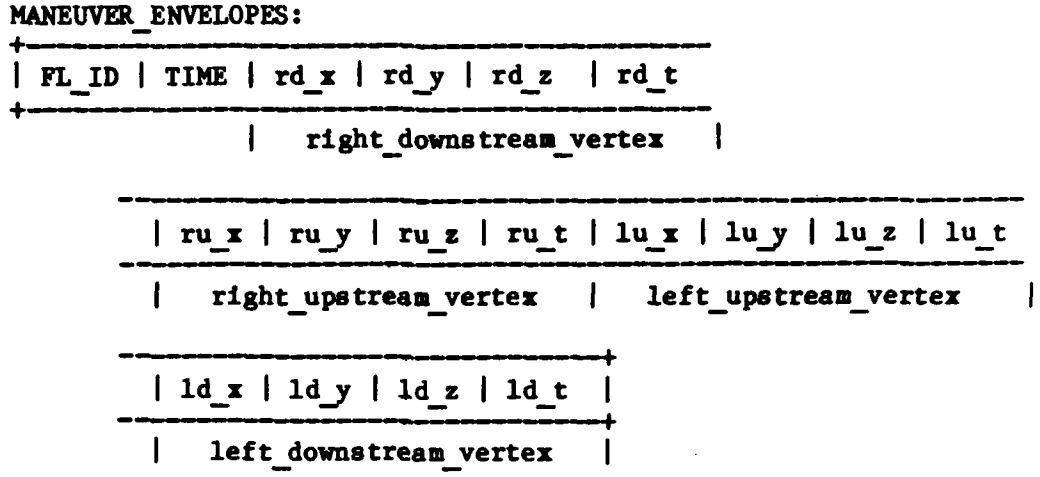
ground_speed — Instantaneous ground speed of the aircraft at this cusp.

cusp_type — The maneuver associated with the segment commencing at this cusp. It may be:

- regular--a straight line traversal of the segment.
- hold--a holding pattern in the horizontal plane.
- vertical hold--a holding pattern with vertical extent.
- vertical--a vertical maneuver.

cusp — AGGREGATE (TIME, x, y, z).

MANEUVER_ENVELOPES:

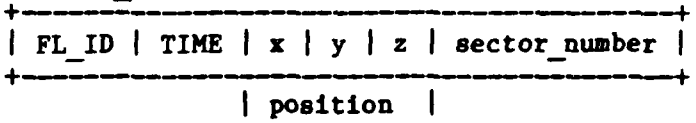


This table identifies an airspace envelope surrounding a portion of a flight plan. Each envelope is associated with a time of a cusp.

FL_ID	A planned path for an aircraft.
TIME	The time of the cusp associated with this maneuver envelope.
rd_x	The x value of the right downstream vertex.
rd_y	The y value of the right downstream vertex.
rd_z	The z value of the right downstream vertex.
rd_t	The t value of the right downstream vertex.
ru_x	The x value of the right upstream vertex.
ru_y	The y value of the right upstream vertex.
ru_z	The z value of the right upstream vertex.
ru_t	The t value of the right upstream vertex.
lu_x	The x value of the left upstream vertex.
lu_y	The y value of the left upstream vertex.
lu_z	The z value of the left upstream vertex.
lu_t	The t value of the left upstream vertex.

ld_x	The x value of the left downstream vertex.
ld_y	The y value of the left downstream vertex.
ld_z	The z value of the left downstream vertex.
ld_t	The t value of the left downstream vertex.

SECTORS_ENTERED:



This table defines the points where a planned trajectory crosses the different sector boundaries in the planning region.

FL_ID	A planned path for an aircraft.
TIME	The time the path crosses the sector boundary.
x	The x value at the sector crossing point.
y	The y value at the sector crossing point.
z	The z value at the sector crossing point.
sector_number	A sector within the planning region through which the path passes.
position	AGGREGATE (x,y,z).

PLANNED_ACTIONS:

PA_ID	fl_id	pa_type	pa_source	plan_time

This table contains information which is common to all planned actions. An entry exists for every planned action currently defined.

PA_ID	A planned action identifier.
fl_id	A planned path for an aircraft.
pa_type	Identifies the type of planned action. May be hold, altitude change, altitude change with restrictions, speed, or vector.
pa_source	Source of the planned action, either system or controller.
plan_time	Time that the planned action was created.

PLANNED_ACTION_DURATION:

PA_ID	pa_start_time	pa_end_time

This table defines the times that a planned action is active. An entry exists in this table for every planned action.

PA_ID	A planned action.
pa_start_time	The first time that the planned action becomes active.
pa_end_time	The time that the planned action is completed or terminated.

ALTITUDE_CHANGE_PLANNED_ACTIONS:

PA_ID	target_altitude	transition_type	base_value_type	base_x	base_y	base_t	base_along_route_distance	resume_climb_time

This table describes altitude change planned actions. An entry exists for each altitude change planned action.

PA_ID	A planned action.
target_altitude	Altitude to be reached by the end of this action.
transition_type	Transition to be performed: ascent or descent.
base_value_type	Type of planned action basing desired: coordinate, time, along route distance, or restriction coordinate.
base_x	The x value of the base point.
base_y	The y value of the base point.
base_t	Time at base point if time is selected.
base_along_route-distance	Along route distance of the base point if ard is selected. The along route distance is the distance traveled projected upon the two-dimensional path of an aircraft.
resume_climb_time	Time to resume climb if this is a climb transition (restricted or based at some other altitude rather than cleared cruise altitude).

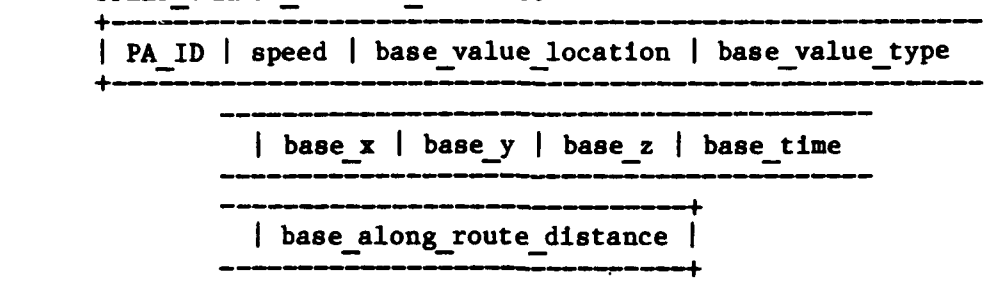
ALTITUDE_RESTRICTIONS_PARAMETERS:

PA_ID	rest_x	rest_y	rest_z	rest_qualifier

This table contains restriction point information for altitude planned actions. An entry exist for each altitude planned action with a restriction point.

PA_ID	An altitude planned action.
rest_x	The x coordinate of the restriction point.
rest_y	The y coordinate of the restriction point.
rest_z	The z coordinate of the restriction point.
rest_qualifier	Indicates whether the restriction point should be crossed at, at or above, at or below the restriction point.

SPEED_CHANGE_PLANNED_ACTIONS:



This table describes speed planned actions. An entry exists for each speed planned action.

PA_ID	A speed planned action.
speed	Speed to be reached by the end of this planned action.
base_value_ location	Location of the base point: the start or end.
base_value_ type	Type of basing requested: coordinate, time, or along route distance.
base_x	The x coordinate of the base point.
base_y	The y coordinate of the base point.
base_z	The z coordinate of the base point.
base_time	Time of base value if time is selected.
base_along_route_ distance	Along route distance of the base point if along route distance is selected.

SPEED_RESTRICTIONS_PARAMETERS:

PA_ID	rest_qualifier

This table contains restriction qualifiers for speed planned actions that contain restrictions. An entry exists for each speed planned action that has a restriction.

PA_ID	A speed restriction planned action.
rest_qualifier	Indicates whether the target speed applies before, at, or after the base point.

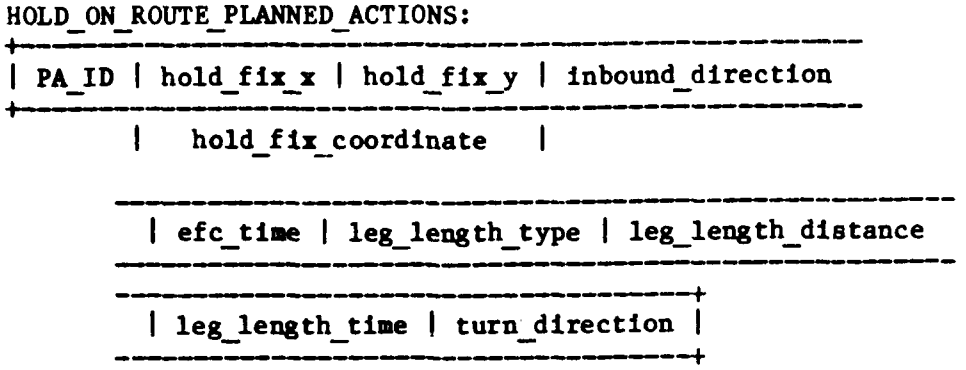
VECTOR_PLANNED_ACTIONS:

PA_ID	VERTEX_SEQUENCE_NUMBER	vertex_coordinate: x	vertex_coordinate: y

This table completes an identification of the vector maneuver for a vector planned action. It lists all the vertices of a vector maneuver except the first which is known as the base point.

PA_ID	Identifies a planned action: in this case, a vector action.
VERTEX_SEQUENCE_NUMBER	The sequence of this vertex with respect to the others for this vector action.
x	The x coordinate of this vertex.
y	The y coordinate of this vertex.
vertex_coordinate	AGGREGATE (x,y).

HOLD_ON_ROUTE_PLANNED_ACTIONS:



This table describes hold planned actions. An entry exists for each hold planned action currently defined.

PA_ID	A planned action.
hold_fix_x	The x coordinate of the position assigned by the controller as a base point for the hold maneuver.
hold_fix_y	The y coordinate of the position assigned by the controller as a base point for the hold maneuver.
inbound_direction	Angular measure (from north) of the direction of inbound leg to the hold fix.
efc_time	The time for which the hold maneuver will be terminated is issued by the controller (expect further clearance time).
leg_length_type	Measure of the leg length: distance or time.
leg_length_ distance	If the length of the leg is measured in distance, this field contains the distance; otherwise, null.
leg_length_time	If the length of the leg is measured in flying time, the field contains the time; othrwise, null.
turn_direction	Direction of the initial turn from the route for the hold maneuver.
hold_fix_ coordinate	AGGREGATE (hold_fix_x, hold_fix_y).

3.3.3 Conflict Data

The following tables describe the contents of the aircraft and environmental cells which are superimposed over the planning region. The grids containing the cells are defined in Section 3.4, System Parameters.

The tables in this section are divided into three groups:

1. Environmental information which exists prior to any conflict monitoring:

   ENVIRONMENTAL_CELL

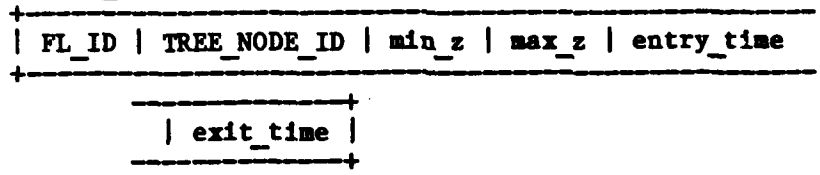
2. Inputs to the conflict probes, which are defined and updated as each aircraft enters the planning region:

   AIRCRAFT_GRID_CHAINS
   FLIGHT_PLAN/ENVIRONMENTAL_CELL

3. Outputs of the conflict probes, which define real conflicts to be presented to the controller:

   AIRCRAFT_CONFLICT
   ENVIRONMENTAL_CONFLICT

SPARSE_CELLS:



This table defines the cells which each flight plan trajectory enters, the range of altitudes the trajectory covers in each cell, and the times associated with the cusp preceding entry and the cusp following exit for each cell.

FL_ID	The planned path for an aircraft.
TREE_NODE_ID	Unique identifier of an airspace cell in an x,y,t grid.
min_z	The lowest altitude of this flight plan trajectory within this cell.
max_z	The highest altitude of this flight plan trajectory within this cell.
entry_time	The time associated with the cusp which precedes entry into this cell.
exit_time	The time associated with the cusp which follows exit from this cell.

ENVIRONMENTAL_CELLS:

CELL_ID	min_x	max_x	min_y	max_y

This table defines the boundaries of each cell used by the airspace probe. One record exists for each cell that contains an E-MSAW area or restricted airspace.

CELL_ID An environmental cell identifier.

min_x The minimum x value of the cell.

max_x The maximum x value of the cell.

min_y The minimum y value of the cell.

max_y The maximum y value of the cell.

ENVIRONMENTAL_CELL_CONTENTS:

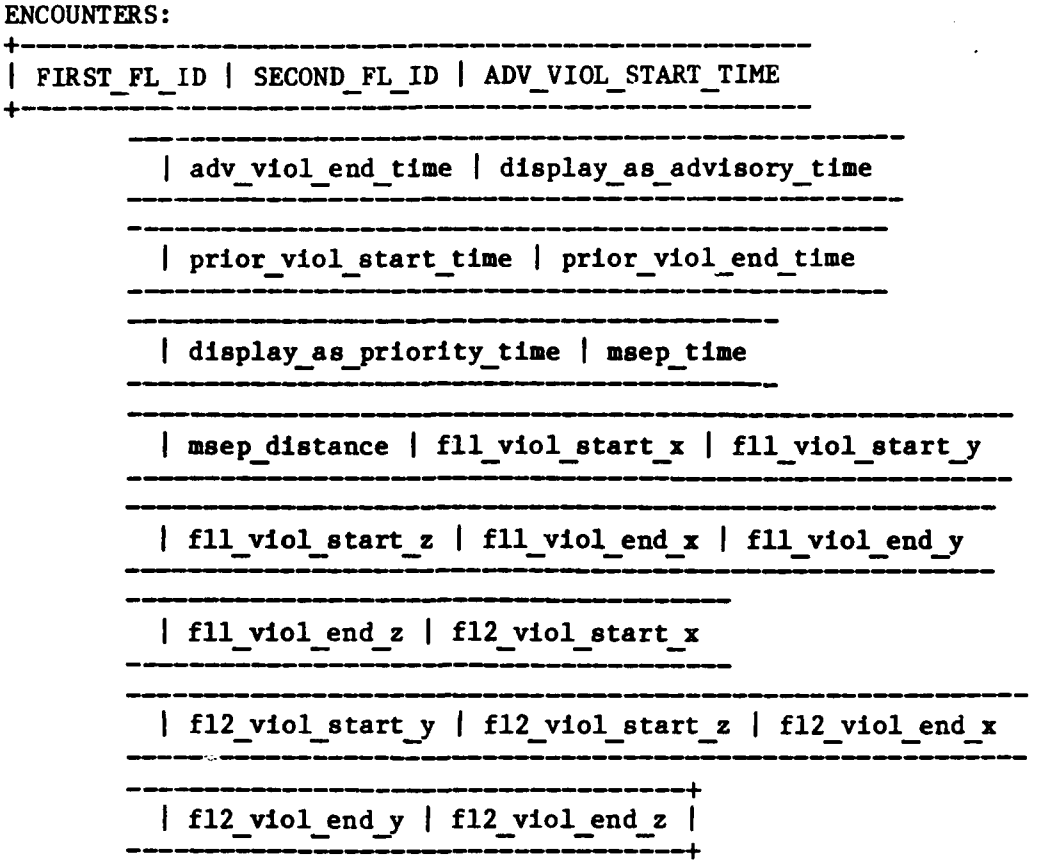
CELL_ID	VOLUME_ID

This table associates the volume identifiers of E-MSAW areas and restricted airspaces with each environmental cell. An entry exists for each volume. If a volume is in several cells, an entry exists for each cell.

CELL_ID An environmental cell identifier.

VOLUME_ID An identifier of an E-MSAW are or restricted airspace volume.

ENCOUNTERS:



This table lists the encounters (violations of vertical and horizontal separation criteria) of all of the aircraft in the planning region.

FIRST_FL_ID	The planned path for one of a pair of aircraft involved in an encounter.
SECOND_FL_ID	The planned path for the second of a pair of aircraft involved in an encounter.
ADV_VIOL_START_ TIME	Earliest time that the advisory horizontal separation criterion is violated.
adv_viol_end_time	Latest time that the advisory horizontal separation criterion is violated.
display_as_ advisory_time	Time at which appropriate controllers are notified of an advisory violation.

prior_viol_start_time	Earliest time that the priority horizontal separation criterion is violated.
prior_viol_end_time	Latest time that the priority horizontal separation criterion is violated.
display_as_priority_time	Time at which appropriate controllers are notified of a priority violation.
msep_time	Time of minimum separation between the aircraft in the horizontal plane.
msep_distance	Minimum separation distance between the aircraft in the horizontal plane.
f11_viol_start_x	The x coordinate of the first aircraft at the start of the advisory violation period.
f11_viol_start_y	The y coordinate of the first aircraft at the start of the advisory violation period.
f11_viol_start_z	The z coordinate of the first aircraft at the start of the advisory violation period.
f11_viol_end_x	The x coordinate of the first aircraft at the end of the advisory violation period.
f11_viol_end_y	The y coordinate of the first aircraft at the end of the advisory violation period.
f11_viol_end_z	The z coordinate of the first aircraft at the end of the advisory violation period.
f12_viol_start_x	The x coordinate of the second aircraft at the start of the advisory violation period.
f12_viol_start_y	The y coordinate of the second aircraft at the start of the advisory violation period.
f12_viol_start_z	The z coordinate of the second aircraft at the start of the advisory violation period.
f12_viol_end_x	The x coordinate of the second aircraft at the end of the advisory violation period.
f12_viol_end_y	The y coordinate of the second aircraft at the end of the advisory violation period.

f12_viol_end_z	The z coordinate of the second aircraft at the end of the advisory violation period.

PRIOR_ENCOUNTERS:

FIRST_FL_ID	SECOND_FL_ID	ADV_VIOL_START_TIME	adv_viol_end_time	display_as_advisory_time	prior_viol_start_time	prior_viol_end_time	display_as_priority_time	msep_time	msep_distance	f11_viol_start_x	f11_viol_start_y	f11_viol_start_z	f11_viol_end_x	f11_viol_end_y	f11_viol_end_z	f12_viol_start_x	f12_viol_start_y	f11_viol_start_z	f12_viol_end_x	f12_viol_end_y	f11_viol_end_z

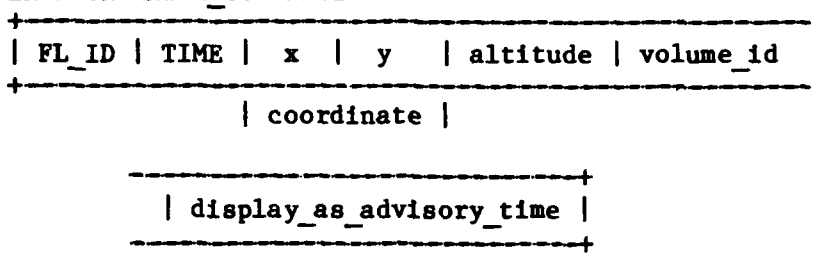
This table contains a copy of the ENCOUNTERS table before the most recent flight plan conflict probe trajectory update.

FIRST_FL_ID	The planned path for one of a pair of aircraft involved in an encounter.
SECOND_FL_ID	The planned path for the second of a pair of aircraft involved in an encounter.
ADV_VIOL_START_TIME	Earliest time that the advisory horizontal separation criterion is violated.

adv_viol_end_time	Latest time that the advisory horizontal separation criterion is violated.
display_as_ advisory_time	Time at which appropriate controllers are notified of an advisory violation.
prior_viol_start_ time	Earliest time that the priority horizontal separation criterion is violated.
prior_viol_end_ time	Latest time that the priority horizontal separation criterion is violated.
display_as_ priority_time	Time at which appropriate controllers are notified of a priority violation.
msep_time	Time of minimum separation between the aircraft in the horizontal plane.
msep_distance	Minimum separation distance between the aircraft in the horizontal plane.
f11_viol_start_x	The x coordinate of the first aircraft at the start of the advisory violation period.
f11_viol_start_y	The y coordinate of the first aircraft at the start of the advisory violation period.
f11_viol_start_z	The z coordinate of the first aircraft at the start of the advisory violation period.
f11_viol_end_x	The x coordinate of the first aircraft at the end of the advisory violation period.
f11_viol_end_y	The y coordinate of the first aircraft at the end of the advisory violation period.
f11_viol_end_z	The z coordinate of the first aircraft at the end of the advisory violation period.
f12_viol_start_x	The x coordinate of the second aircraft at the start of the advisory violation period.
f12_viol_start_y	The y coordinate of the second aircraft at the start of the advisory violation period.
f12_viol_start_z	The z coordinate of the second aircraft at the start of the advisory violation period.

f12_viol_end_x	The x coordinate of the second aircraft at the end of the advisory violation period.
f12_viol_end_y	The y coordinate of the second aircraft at the end of the advisory violation period.
f12_viol_end_z	The z coordinate of the second aircraft at the end of the advisory violation period.

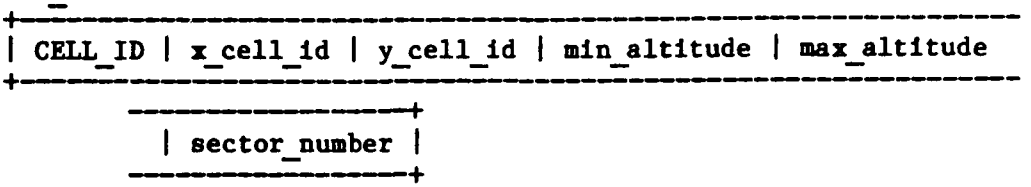
ENVIRONMENTAL_CONFLICT:



This table describes a real conflict that is detected by the airspace probe.

FL_ID	Unique identifier of the subject aircraft's flight plan.
TIME	Time at which the flight trajectory intersects the boundary in the cell.
x	The value of x at the conflict.
y	The value of y at the conflict.
altitude	Altitude at which the flight trajectory intersects the boundary in the cell.
volume_id	Identifier of the volume with which the flight plan is in conflict.
display_as_ advisory_ time	Time at which appropriate controllers are to be notified of an advisory violation.
coordinate	AGGREGATE (x,y).

SWP_CELL:



This table defines the values of the x, y, and z dimensions associated with each three-dimensional cell in the ARTCC (Center) used by Sector Workload Probe.

CELL_ID	Unique identifier of an airspace cell in an x,y,z grid.
x_cell_id	Identifier for the value of the x dimension of the cell.
y_cell_id	Identifier for the value of the y dimension of the cell.
min_altitude	The lowest altitude associated with the cell.
max_altitude	The highest altitude associated with the cell.
sector_number	The sector (uncombined) which this cell occupies.

SECTORIZATION_SCHEDULE:

AREA_NAME	TIME	plan_type

This table describs the sectorization schedule for an area according to the time of day. For instance, in times of light traffic, several sectors in an area may be combined. In times of heavy traffic, each sector in an area may be operating independently under the sectorization plan.

AREA_NAME — A name of a group of sectors.

TIME — The time the sectorization plan becomes effective for this area.

plan_type — A value which represents one type of sectorization plan such as:

- all sectors operating
- first sector combined
- late evening traffic flow
- midnight shift traffic flow

SECTORIZATION_PLAN:

SECTOR_NUMBER	PLAN_TYPE	area_name	combined_sector_number

This table describes the sectorization plans for basic sectors in the center. The basic sector is organized under various combined sectors depending on the plan type. All possible sectorization plans which may be used are included in this table.

SECTOR_NUMBER	The smallest sector number.
PLAN_TYPE	A number which represents one type of sectorization plan, such as: • all sectors operating • first sector combined • late evening traffic flow • midnight shift traffic flow
area_name	A name of a group of sectors.
combined_sector_number	The sector number of the principal sector with which the basic sector is associated.

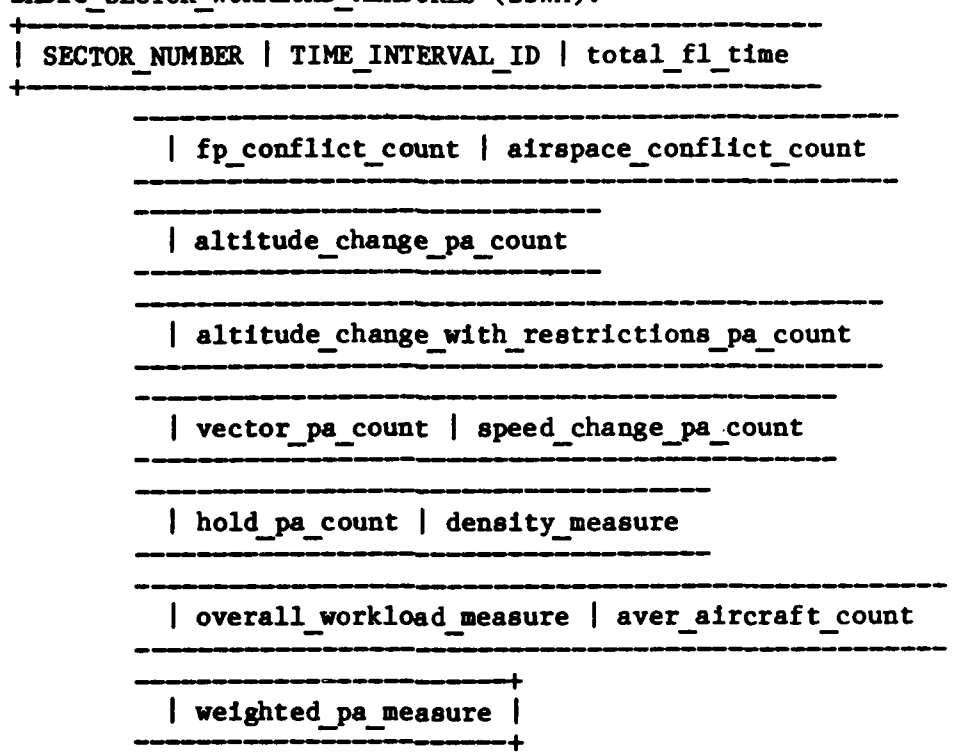
WORKLOAD_THRESHOLDS:

SECTOR_NUMBER	WORKLOAD_MEASURE	threshold_value	time

These records contain a threshold value which is set by the supervisor for a specific workload measure within a sector. The supervisor is notified if the measure crosses the threshold value.

SECTOR_NUMBER	The sector for which the supervisor sets the threshold value.
WORKLOAD_MEASURE	The measure in which the supervisor is interested. May be one of the following: aircraft count measure, planned action measure, flight plan conflict measure, airspace conflict measure, or density measure.
threshold_value	The threshold (set by a supervisor) for the workload measure value, above or below which the supervisor will be notified.
time	The time of display for a message stating the threshold has been crossed.

BASIC_SECTOR_WORKLOAD_MEASURES (BSWM):

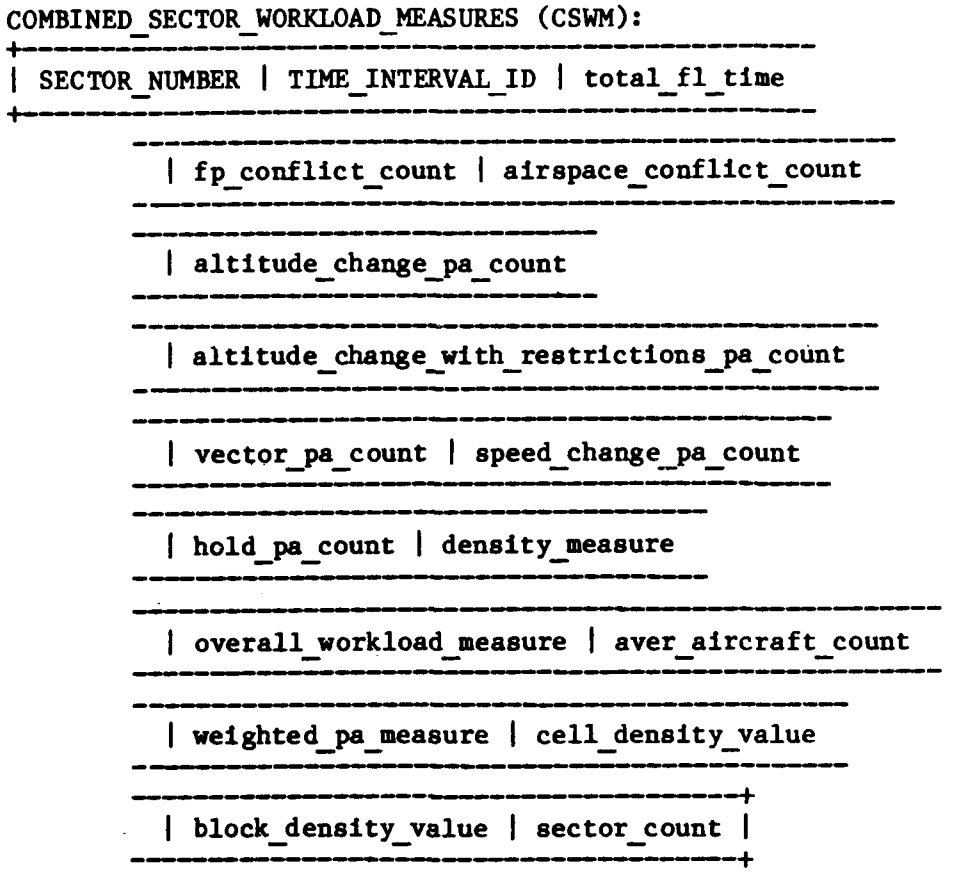


These records define the workload statistics output by the sector workload probe.

SECTOR_NUMBER	Number of the sector.
TIME_INTERVAL_ID	The time interval for which these statistics are calculated.
total_fl_time	Total flight time of all the aircraft within the sector during the time interval specified.
fp_conflict_count	Number of encounters detected by flight plan conflict probe during the time interval for the sector.
airspace_conflict_ count	Number of encounters detected by airspace probe during the time interval for the sector.
altitude_change_ pa_count	Number of altitude change planned actions for the sector time interval.

altitude_change_with_restrictions_pa_count	Number of altitude change with restrictions planned action for the sector time interval.
vector_pa_count	Number of vector planned actions for the sector time interval.
speed_change_pa_count	Number of speed change planned actions for the sector time interval.
hold_pa_count	Number of hold planned actions for the sector time interval.
density_measure	A measure of the airspace density during the time interval for the sector.
overall_workload_measure	Combined workload measure for the sector and time interval.
aver_aircraft_count	Average number of aircraft for the sector time interval.
weighted_pa_measure	Weighted planned action value for the sector time interval.
pa_counts	AGGREGATE (altitude_change_pa_count, altitude change_with_restrictions_pa_count, vector_pa count, speed_change_pa_count, hold_pa_count).

COMBINED_SECTOR_WORKLOAD_MEASURES (CSWM):



These records define the workload statistics output by the sector workload probe.

SECTOR_NUMBER	Number of the sector.
TIME_INTERVAL_ID	The time interval for which these statistics are calculated.
total_fl_time	Total flight time of all the aircraft within the sector during the time interval specified.
fp_conflict_count	Number of encounters detected by flight plan conflict probe during the time interval for the sector.
airspace_conflict_ count	Number of encounters detected by airspace probe during the time interval for the sector.

altitude_change_pa_count	Number of altitude change planned actions for the sector time interval.
altitude_change_with_restrictions_pa_count	Number of altitude change with restrictions planned action for the sector time interval.
vector_pa_count	Number of vector planned actions for the sector time interval.
speed_change_pa_count	Number of speed change planned actions for the sector time interval.
hold_pa_count	Number of hold planned actions for the sector time interval.
density_measure	A measure of the airspace density during the time interval for the sector.
overall_workload_measure	Combined workload measure for the sector and time interval.
aver_aircraft_count	Average number of aircraft for the sector time interval.
weighted_pa_measure	Weighted planned action value for the sector time interval.
pa_counts	AGGREGATE (altitude_change_pa_count, altitude change_with_restrictions_pa_count, vector_pa count, speed_change_pa_count, hold_pa_count).
cell_density_value	Sum of percent of aircraft for cell density for sector time interval.
block_density_value	Sum of percent of aircraft for block density for sector time interval.
sector_count	Number of basic sectors for the combined sector under the sectorization plan.

3.4 System Parameters

Each of the system parameters is referenced as a separate entity.

Flight Plan Conflict Probe

Advisory_Seph	Horizontal separation criterion used by Flight Plan Conflict Probe to detect advisory violations (see Flight Plan Conflict Probe for definition of advisory violations).
Priority_Seph	Horizontal separation criterion used by Flight Plan Conflict Probe to detect priority violations.
Sepz_Hi	Vertical separation criterion used by Flight Plan Conflict Probe to identify the loss of vertical separation between two aircraft, at least one of which is above FL290.
Sepz_Lo	Vertical separation criterion used by Flight Plan Conflict Probe to identify the loss of vertical separation between two aircraft, both of which are at or below FL290.
Advisory_Sept	Length of time between the notification of a controller of an advisory violation and the start of the violation.
Priority_Sept	Length of time between the notification of a controller of a priority violation and the start of the violation.

Hold PA Parameters

These parameters define the system default values for holding pattern planned actions.

Holding_Leg_Length	Length of a holding pattern track leg.
Holding_Pattern_ Buffer	The region protecting a holding pattern.

Workload Probe Parameters

These parameters include the time parameters for which the data will be accumulated, and coefficients for determining aircraft, pa, and conflict counts.

Time_Horizon	The time interval for which the sector workload probe evaluates its workload measures.
Display_Time_ Horizon	The maximum time in the future that probe values will be displayed (this is less than the time-horizon).
Time_Interval	The smallest quantization of the time-horizon for which workload probe measures are calculated and displayed.
Ac_Coefficient	A value which is used as the coefficient for aircraft counts collected during time_ interval.
Airspace_Cfl_ Coefficient	A value which is used as the coefficient for airspace conflict counts collected during time_interval.
Flight_Plan_ Cfl_Coefficient	A value which is used as the coefficient for flight-plan conflict counts collected during time_interval.
Density_ Coefficient	A value which is used as the coefficient for the density measures.
Altitude_Change_ Pa_Coefficient	A value which is used as the coefficient for altitude change pa counts during a time interval.
Altitude_Change_ With_Restrictions_ Pa_Coefficient	A value which is used as the coefficient for altitude change with restrictions pa counts during a time interval.
Vector_Pa_ Coefficient	A value which is used as the coefficient for vector pa counts during a time interval.
Speed_Pa_ Coefficient	A value which is used as the coefficient for speed pa counts during a time interval.

Hold_Pa_ Coefficient	A value which is used as the coefficient for hold pa counts during a time interval.
Pa_Coefficients	AGGREGATE (Altitude_Change_Pa_Coeff, Altitude_Change_With_Restrictions_Pa_Coeff, Vector_Pa_Coeff, Speed_Pa_Coeff, Speed_Pa_ Coeff, Hold_Pa_Coeff).
Cell_Density_Ratio	Proportion of the density value for cells used in the combined density value for cells and blocks.

Environmental Grid Parameters

Cell_Width	Initial width of the cells which compose the grid.

APPENDIX A

NORMALIZATION RULES

The normalization process is explained in varying amounts of detail in different sources [1,2,3,4]. Codd's paper [1] is the first paper on relational data bases; it outlines the need for and the advantages of using the method. Kent's paper [2] is a good non-technical presentation of the whys and hows of data normalization. The book by Date [3] contains a technical presentation of relational models. The book by Martin [4] gives step-by-step implementation techniques for normalizing data relations. The following descriptions of the rules were taken largely from Kent's paper.

A.1 First Normal Form

ALL OCCURRENCES OF A RECORD TYPE MUST HAVE THE SAME NUMBER OF FIELDS, AND EACH FIELD MUST CONTAIN ONLY ONE OCCURRENCE. For example, the table

PATH_ID	fix_1	fix_2	...	fix_n

does not conform to first normal form because there are a variable number of fixes depending on the path chosen. Neither is it legal to format the table as

PATH_ID	list of fix_names

since first normal form, by definition, is a flat arrangement of data containing only one occurrence of each field in a table. The table should be

PATH_ID	fix_name

where every occurrence of a fix is recorded in a separate table, and the table is keyed by path-id and fix-name. Fix order is not presented in any way in his table. Another table defines the location of each fix.

A.2 Second Normal Form

EACH NONKEY FIELD MUST BE A FACT ABOUT THE ENTIRE KEY. For example, the table

AC_TYPE	ALTITUDE	min_speed	max_speed	max_passgrs

is not in second normal form because the field (max)passgrs does not describe altitude, which is part of the key. The table must therefore be split into two tables:

AC_TYPE	ALTITUDE	min_speed	max_speed

and

AC_TYPE	max_passgrs

A.3 Third Normal Form

A NONKEY FIELD CANNOT BE DEPENDENT ON ANOTHER NONKEY FIELD. It must describe only the key. For instance, the table

AC_TYPE	altitude	min_speed

does not conform to third normal form because the minimum speed is dependent on altitude, which is shown to be a nonkey field. If altitude were part of the key, the table would be valid.

A.4 Fourth Normal Form

A RECORD CANNOT HAVE TWO OR MORE INDEPENDENT MULTI-VALUED FIELDS. To illustrate, an example is taken directly from Kent's paper [2]:

> "Consider employees, skills, and languages, where an employee may have several skills and several languages. We have here two many-to-many relationships, one between employees and skills, and one between employees and languages. Under fourth normal form, these two relationships should not be represented in a single table such as

EMPLOYEE	SKILL	LANGUAGE

Instead, they should be represented in the two tables

EMPLOYEE	SKILL

and

EMPLOYEE	LANGUAGE

The main problem with violating fourth normal form is that it leads to uncertainties in the maintenance policies. Several policies are possible for maintaining two independent multivalued facts in one table."

A.5 Fifth Normal Form

A RECORD IS IN FIFTH NORMAL FORM WHEN ITS INFORMATION CONTENT CANNOT BE RECONSTRUCTED FROM SEVERAL SMALLER RECORD TYPES. (The case where all the smaller table types have the same key is the exception.) This form further serves to eliminate redundancies, but differs from fourth normal form because even though the fields may be related, they are still separated into different tables.

APPENDIX B

ALPHABETICAL LIST OF FULLY QUALIFIED NAMES AND PARAMETERS

The fully qualified names in each table are listed below in alphabetical order. Also listed at the end of this appendix are the global parameters in alphabetical order within a functional grouping.

ADAPTED_FIXES.FIX_NAME
ADAPTED_FIXES.fix_type
ADAPTED_FIXES.x
ADAPTED_FIXES.y

AIRCRAFT_ACCELERATION.acceleration
AIRCRAFT_ACCELERATION.ALTITUDE
AIRCRAFT_ACCELERATION.SOURCE

AIRCRAFT_CURRENT_CLEARANCE.altitude
AIRCRAFT_CURRENT_CLEARANCE.FLIGHT_NAME
AIRCRAFT_CURRENT_CLEARANCE.speed

AIRCRAFT_LRC_SPEED.ALTITUDE
AIRCRAFT_LRC_SPEED.SOURCE
AIRCRAFT_LRC_SPEED.speed

AIRCRAFT_MAX_ENDURANCE_SPEED.ALTITUDE
AIRCRAFT_MAX_ENDURANCE_SPEED.SOURCE
AIRCRAFT_MAX_ENDURANCE_SPEED.speed

AIRCRAFT_MIN_MAX_SPEED.ALTITUDE
AIRCRAFT_MIN_MAX_SPEED.max_speed
AIRCRAFT_MIN_MAX_SPEED.min_speed
AIRCRAFT_MIN_MAX_SPEED.SOURCE

AIRCRAFT_TRACKED_POSITION.along_route_distance
AIRCRAFT_TRACKED_POSITION.FLIGHT_NAME
AIRCRAFT_TRACKED_POSITION.TIME
AIRCRAFT_TRACKED_POSITION.velocity_x
AIRCRAFT_TRACKED_POSITION.velocity_y
AIRCRAFT_TRACKED_POSITION.velocity_z
AIRCRAFT_TRACKED_POSITION.x
AIRCRAFT_TRACKED_POSITION.y
AIRCRAFT_TRACKED_POSITION.z

AIRWAYS.AIRWAY_NAME
AIRWAYS.fix_name
AIRWAYS.VERTEX_NUMBER

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ALTITUDE_CHANGE_PLANNED_ACTIONS.base_along_route_distance
ALTITUDE_CHANGE_PLANNED_ACTIONS.base_t
ALTITUDE_CHANGE_PLANNED_ACTIONS.base_value_type
ALTITUDE_CHANGE_PLANNED_ACTIONS.base_x
ALTITUDE_CHANGE_PLANNED_ACTIONS.base_y
ALTITUDE_CHANGE_PLANNED_ACTIONS.PA_ID
ALTITUDE_CHANGE_PLANNED_ACTIONS.resume_climb_time
ALTITUDE_CHANGE_PLANNED_ACTIONS.target_altitude
ALTITUDE_CHANGE_PLANNED_ACTIONS.transition_type

ALTITUDE_RESTRICTIONS_PARAMETERS.PA_ID
ALTITUDE_RESTRICTIONS_PARAMETERS.rest_qualifier
ALTITUDE_RESTRICTIONS_PARAMETERS.rest_x
ALTITUDE_RESTRICTIONS_PARAMETERS.rest_y
ALTITUDE_RESTRICTIONS_PARAMETERS.rest_z

BASIC_SECTOR_WORKLOAD_MEASURES.airspace_conflict_count
BASIC_SECTOR_WORKLOAD_MEASURES.altitude_change_pa_count
BASIC_SECTOR_WORKLOAD_MEASURES.altitude_change_with_
  restrictions_pa_count
BASIC_SECTOR_WORKLOAD_MEASURES.aver_aircraft_count
BASIC_SECTOR_WORKLOAD_MEASURES.density_measure
BASIC_SECTOR_WORKLOAD_MEASURES.fp_conflict_count
BASIC_SECTOR_WORKLOAD_MEASURES.hold_pa_count
BASIC_SECTOR_WORKLOAD_MEASURES.overall_workload_measure
BASIC_SECTOR_WORKLOAD_MEASURES.SECTOR_NUMBER
BASIC_SECTOR_WORKLOAD_MEASURES.speed_change_pa_count
BASIC_SECTOR_WORKLOAD_MEASURES.TIME_INTERVAL_ID
BASIC_SECTOR_WORKLOAD_MEASURES.total_fl_time
BASIC_SECTOR_WORKLOAD_MEASURES.vector_pa_count
BASIC_SECTOR_WORKLOAD_MEASURES.weighted_pa_measure

CLIMB_IAS_TO_GRADIENT.BEG_ALTITUDE
CLIMB_IAS_TO_GRADIENT.end_altitude
CLIMB_IAS_TO_GRADIENT.GRADIENT
CLIMB_IAS_TO_GRADIENT.gradient_type
CLIMB_IAS_TO_GRADIENT.SOURCE
CLIMB_IAS_TO_GRADIENT.SPEED

CLIMB_MACH_TO_GRADIENT.BEG_ALTITUDE
CLIMB_MACH_TO_GRADIENT.end_altitude
CLIMB_MACH_TO_GRADIENT.GRADIENT
CLIMB_MACH_TO_GRADIENT.gradient_type
CLIMB_MACH_TO_GRADIENT.SOURCE
CLIMB_MACH_TO_GRADIENT.SPEED

COMBINED_SECTOR_WORKLOAD_MEASURE.airspace_conflict_count
COMBINED_SECTOR_WORKLOAD_MEASURE.altitude_change_pa_count
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COMBINED_SECTOR_WORKLOAD_MEASURE.altitude_change_with_
  restrictions_pa_count
COMBINED_SECTOR_WORKLOAD_MEASURE.aver_aircraft_count
COMBINED_SECTOR_WORKLOAD_MEASURE.block_density_value
COMBINED_SECTOR_WORKLOAD_MEASURE.cell_density_value
COMBINED_SECTOR_WORKLOAD_MEASURE.density_measure
COMBINED_SECTOR_WORKLOAD_MEASURE.fp_conflict_count
COMBINED_SECTOR_WORKLOAD_MEASURE.hold_pa_count
COMBINED_SECTOR_WORKLOAD_MEASURE.overall_workload_measure
COMBINED_SECTOR_WORKLOAD_MEASURE.sector_count
COMBINED_SECTOR_WORKLOAD_MEASURE.SECTOR_NUMBER
COMBINED_SECTOR_WORKLOAD_MEASURE.TIME_INTERVAL_ID
COMBINED_SECTOR_WORKLOAD_MEASURE.total_fl_time
COMBINED_SECTOR_WORKLOAD_MEASURE.speed_change_pa_count
COMBINED_SECTOR_WORKLOAD_MEASURE.vector_pa_count
COMBINED_SECTOR_WORKLOAD_MEASURE.weighted_pa_measure

CURRENT_TIME.date
CURRENT_TIME.time

DESCENT_IAS_TO_GRADIENT.BEG_ALTITUDE
DESCENT_IAS_TO_GRADIENT.end_altitude
DESCENT_IAS_TO_GRADIENT.GRADIENT
DESCENT_IAS_TO_GRADIENT.gradient_type
DESCENT_IAS_TO_GRADIENT.SOURCE
DESCENT_IAS_TO_GRADIENT.SPEED

DESCENT_MACH_TO_GRADIENT.BEG_ALTITUDE
DESCENT_MACH_TO_GRADIENT.end_altitude
DESCENT_MACH_TO_GRADIENT.GRADIENT
DESCENT_MACH_TO_GRADIENT.gradient_type
DESCENT_MACH_TO_GRADIENT.SOURCE
DESCENT_MACH_TO_GRADIENT.SPEED

E_MSAW_AREAS.E_MSAW_NAME
E_MSAW_AREAS.volume_id

ENCOUNTERS.adv_viol_end_time
ENCOUNTERS.ADV_VIOL_START_TIME
ENCOUNTERS.display_as_advisory_time
ENCOUNTERS.display_as_priority_time
ENCOUNTERS.FIRST_FL_ID
ENCOUNTERS.fl1_viol_end_x
ENCOUNTERS.fl1_viol_end_y
ENCOUNTERS.fl1_viol_end_z
ENCOUNTERS.fl1_viol_start_x
ENCOUNTERS.fl1_viol_start_y
ENCOUNTERS.fl1_viol_start_z
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ENCOUNTERS.f12_viol_end_x
ENCOUNTERS.f12_viol_end_y
ENCOUNTERS.f12_viol_end_z
ENCOUNTERS.f12_viol_start_x
ENCOUNTERS.f12_viol_start_y
ENCOUNTERS.f12_viol_start_z
ENCOUNTERS.msep_distance
ENCOUNTERS.msep_time
ENCOUNTERS.prior_viol_end_time
ENCOUNTERS.prior_viol_start_time
ENCOUNTERS.SECOND_FL_ID

ENVIRONMENTAL_CELL_CONTENTS.CELL_ID
ENVIRONMENTAL_CELL_CONTENTS.VOLUME_ID

ENVIRONMENTAL_CELLS.CELL_ID
ENVIRONMENTAL_CELLS.max_x
ENVIRONMENTAL_CELLS.max_y
ENVIRONMENTAL_CELLS.min_x
ENVIRONMENTAL_CELLS.min_y

ENVIRONMENTAL_CONFLICT.altitude
ENVIRONMENTAL_CONFLICT.display_as_advisory_time
ENVIRONMENTAL_CONFLICT.FL_ID
ENVIRONMENTAL_CONFLICT.TIME
ENVIRONMENTAL_CONFLICT.volume_id
ENVIRONMENTAL_CONFLICT.x
ENVIRONMENTAL_CONFLICT.y

FL_ID_ASSOCIATIONS.FL_ID
FL_ID_ASSOCIATIONS.fl_id_type
FL_ID_ASSOCIATIONS.flight_name

FLIGHT_PLANS.aircraft_type
FLIGHT_PLANS.approved_cruise_altitude
FLIGHT_PLANS.approved_route_string
FLIGHT_PLANS.approved_true_air_speed
FLIGHT_PLANS.arrival_procedure_name
FLIGHT_PLANS.arrival_procedure_type
FLIGHT_PLANS.beacon_code
FLIGHT_PLANS.dep_arr_procedure_name
FLIGHT_PLANS.dep_arr_procedure_type
FLIGHT_PLANS.departure_procedure_name
FLIGHT_PLANS.departure_procedure_type
FLIGHT_PLANS.destination
FLIGHT_PLANS.equippage
FLIGHT_PLANS.FLIGHT_NAME
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FLIGHT_PLANS.origin
FLIGHT_PLANS.weight

HOLD_ON_ROUTE_PLANNED_ACTIONS.efc_time
HOLD_ON_ROUTE_PLANNED_ACTIONS.hold_fix_x
HOLD_ON_ROUTE_PLANNED_ACTIONS.hold_fix_y
HOLD_ON_ROUTE_PLANNED_ACTIONS.inbound_direction
HOLD_ON_ROUTE_PLANNED_ACTIONS.leg_length_distance
HOLD_ON_ROUTE_PLANNED_ACTIONS.leg_length_time
HOLD_ON_ROUTE_PLANNED_ACTIONS.leg_length_type
HOLD_ON_ROUTE_PLANNED_ACTIONS.PA_ID
HOLD_ON_ROUTE_PLANNED_ACTIONS.turn_direction

MANEUVER_ENVELOPES.FL_ID
MANEUVER_ENVELOPES.ld_t
MANEUVER_ENVELOPES.ld_x
MANEUVER_ENVELOPES.ld_y
MANEUVER_ENVELOPES.ld_z
MANEUVER_ENVELOPES.lu_t
MANEUVER_ENVELOPES.lu_x
MANEUVER_ENVELOPES.lu_y
MANEUVER_ENVELOPES.lu_z
MANEUVER_ENVELOPES.rd_t
MANEUVER_ENVELOPES.rd_x
MANEUVER_ENVELOPES.rd_y
MANEUVER_ENVELOPES.rd_z
MANEUVER_ENVELOPES.ru_t
MANEUVER_ENVELOPES.ru_x
MANEUVER_ENVELOPES.ru_y
MANEUVER_ENVELOPES.ru_z
MANEUVER_ENVELOPES.TIME

NOMINAL_CLIMB_SPEEDS.ias
NOMINAL_CLIMB_SPEEDS.mach
NOMINAL_CLIMB_SPEEDS.SOURCE

NOMINAL_DESCENT_SPEEDS.ias
NOMINAL_DESCENT_SPEEDS.mach
NOMINAL_DESCENT_SPEEDS.SOURCE

PLANNED_ACTION_DURATION.pa_end_time
PLANNED_ACTION_DURATION.PA_ID
PLANNED_ACTION_DURATION.pa_start_time

PLANNED_ACTIONS.fl_id
PLANNED_ACTIONS.PA_ID
PLANNED_ACTIONS.pa_source
PLANNED_ACTIONS.pa_type
PLANNED_ACTIONS.plan_time
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PRIOR_ENCOUNTERS.adv_viol_end_time
PRIOR_ENCOUNTERS.ADV_VIOL_START_TIME
PRIOR_ENCOUNTERS.display_as_advisory_time
PRIOR_ENCOUNTERS.display_as_priority_time
PRIOR_ENCOUNTERS.FIRST_FL_ID
PRIOR_ENCOUNTERS.fl1_viol_end_x
PRIOR_ENCOUNTERS.fl1_viol_end_y
PRIOR_ENCOUNTERS.fl1_viol_end_z
PRIOR_ENCOUNTERS.fl1_viol_start_x
PRIOR_ENCOUNTERS.fl1_viol_start_y
PRIOR_ENCOUNTERS.fl1_viol_start_z
PRIOR_ENCOUNTERS.fl2_viol_end_x
PRIOR_ENCOUNTERS.fl2_viol_end_y
PRIOR_ENCOUNTERS.fl2_viol_end_z
PRIOR_ENCOUNTERS.fl2_viol_start_x
PRIOR_ENCOUNTERS.fl2_viol_start_y
PRIOR_ENCOUNTERS.fl2_viol_start_z
PRIOR_ENCOUNTERS.msep_distance
PRIOR_ENCOUNTERS.msep_time
PRIOR_ENCOUNTERS.prior_viol_end_time
PRIOR_ENCOUNTERS.prior_viol_start_time
PRIOR_ENCOUNTERS.SECOND_FL_ID

ROUTES.ALONG_ROUTE_DISTANCE
ROUTES.FL_ID
ROUTES.x
ROUTES.y

SECTOR_SHELVES.SECTOR_NUMBER
SECTOR_SHELVES.SHELF_NAME
SECTOR_SHELVES.volume_id

SECTORIZATION_PLAN.area_name
SECTORIZATION_PLAN.combined_sector_number
SECTORIZATION_PLAN.PLAN_TYPE
SECTORIZATION_PLAN.SECTOR_NUMBER

SECTORIZATION_SCHEDULE.AREA_NAME
SECTORIZATION_SCHEDULE.plan_type
SECTORIZATION_SCHEDULE.TIME

SECTORS.center_name
SECTORS.sector_name
SECTORS.SECTOR_NUMBER
SECTORS.volume_id

SECTORS_ENTERED.FL_ID
SECTORS_ENTERED.sector_number
```

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SECTORS_ENTERED.TIME
SECTORS_ENTERED.x
SECTORS_ENTERED.y
SECTORS_ENTERED.z

SPARSE_CELLS.entry_time
SPARSE_CELLS.exit_time
SPARSE_CELLS.FL_ID
SPARSE_CELLS.max_z
SPARSE_CELLS.min_z
SPARSE_CELLS.TREE_NODE_ID

SPECIAL_USE_AIRSPACES.airspace_type
SPECIAL_USE_AIRSPACES.SPECIAL_USE_AIRSPACE_NAME
SPECIAL_USE_AIRSPACES.start_time
SPECIAL_USE_AIRSPACES.stop_time
SPECIAL_USE_AIRSPACES.volume_id

SPEED_CHANGE_PLANNED_ACTIONS.base_along_route_distance
SPEED_CHANGE_PLANNED_ACTIONS.base_time
SPEED_CHANGE_PLANNED_ACTIONS.base_value_location
SPEED_CHANGE_PLANNED_ACTIONS.base_value_type
SPEED_CHANGE_PLANNED_ACTIONS.base_x
SPEED_CHANGE_PLANNED_ACTIONS.base_y
SPEED_CHANGE_PLANNED_ACTIONS.base_z
SPEED_CHANGE_PLANNED_ACTIONS.PA_ID
SPEED_CHANGE_PLANNED_ACTIONS.speed

SPEED_RESTRICTIONS_PARAMETERS.PA_ID
SPEED_RESTRICTIONS_PARAMETERS.rest_qualifier

SWP_CELL.CELL_ID
SWP_CELL.max_altitude
SWP_CELL.min_altitude
SWP_CELL.sector_number
SWP_CELL.x_cell_id
SWP_CELL.y_cell_id

TRAJECTORIES.cusp_type
TRAJECTORIES.FL_ID
TRAJECTORIES.ground_speed
TRAJECTORIES.TIME
TRAJECTORIES.x
TRAJECTORIES.y
TRAJECTORIES.z

VECTOR_PLANNED_ACTIONS.PA_ID
VECTOR_PLANNED_ACTIONS.VERTEX_SEQUENCE_NUMBER
```

VECTOR_PLANNED_ACTIONS.x
VECTOR_PLANNED_ACTIONS.y

VOLUME_COORDINATES.VERTEX_NUMBER
VOLUME_COORDINATES.VOLUME_ID
VOLUME_COORDINATES.x
VOLUME_COORDINATES.y

VOLUMES.ceiling_altitude
VOLUMES.floor_altitude
VOLUMES.polygon_type
VOLUMES.VOLUME_ID
VOLUMES.volume_type

WINDS.blt_x
WINDS.blt_y
WINDS.blt_z
WINDS.direction
WINDS.flb_x
WINDS.flb_y
WINDS.flb_z
WINDS.frb_x
WINDS.frb_y
WINDS.frb_z
WINDS.speed
WINDS.temperature
WINDS.time
WINDS.WIND_CELL_ID

WORKLOAD_THRESHOLDS.SECTOR_NUMBER
WORKLOAD_THRESHOLDS.threshold_value
WORKLOAD_THRESHOLDS.time
WORKLOAD_THRESHOLDS.WORKLOAD_MEASURE

Environmental Grid Parameters

Cell_Width

Flight Plan Conflict Probe Parameters

Advisory_Seph
Advisory_Sept
Priority_Seph
Priority_Sept
Sepz_Hi
Sepz_Lo

Hold PA Parameters

Holding_Leg_Length
Holding_Pattern_Buffer

Workload Probe Parameters

Ac_Coefficient
Airspace_Cfl_Coefficient
Altitude_Change_Pa_Coefficient
Altitude_Change_With_Restrictions_Pa_
  Coefficient
Cell_Density_Ratio
Density_Coefficient
Display_Time_Horizon
Flight_Plan_Cfl_Coefficient
Hold_Pa_Coefficient
Pa_Coefficients
Speed_Pa_Coefficient
Time_Horizon
Time_Interval
Vector_Pa_Coefficient

APPENDIX C

FIELD TYPE AND TABLE CROSS REFERENCE

Below is a list of field types and the tables in which each field type appears. A field type is the last term of the name (for instance, the type of beg-altitude is altitude; the type of holding-pattern-buffer is buffer). Following the table name in parentheses is the modifier of the field type. When a prefix is shown in all caps, the field is also the key (or part of the key) of the table. System parameters are not included in this cross reference.

acceleration
- AIRCRAFT_ACCELERATION

altitude (see also "z")
- AIRCRAFT_ACCELERATION
- AIRCRAFT_LRC_SPEED
- AIRCRAFT_MAX_ENDURANCE_SPEED
- AIRCRAFT_MIN_MAX_SPEED
- ALTITUDE_CHANGE_PLANNED_ACTIONS (target_)
- AIRCRAFT_CURRENT_CLEARANCE
- CLIMB_IAS_TO_GRADIENT (BEG_)
- CLIMB_IAS_TO_GRADIENT (end_)
- CLIMB_MACH_TO_GRADIENT (BEG_)
- CLIMB_MACH_TO_GRADIENT (end_)
- DESCENT_IAS_TO_GRADIENT (BEG_)
- DESCENT_IAS_TO_GRADIENT (end_)
- DESCENT_MACH_TO_GRADIENT (BEG_)
- DESCENT_MACH_TO_GRADIENT (end_)
- ENVIRONMENTAL_CONFLICT
- FLIGHT_PLANS (approved_cruise_)
- SWP_CELL (max_)
- SWP_CELL (min_)
- VOLUMES (ceiling_)
- VOLUMES (floor_)

code
- FLIGHT_PLANS (beacon_)

count
- BASIC_SECTOR_WORKLOAD_MEASURES (airspace-conflict_)
- BASIC_SECTOR_WORKLOAD_MEASURES (altitude_change_pa_)
- BASIC_SECTOR_WORKLOAD_MEASURES (altitude_change_with_restrictions_pa_)
- BASIC_SECTOR_WORKLOAD_MEASURES (aver_aircraft_)
- BASIC_SECTOR_WORKLOAD_MEASURES (fp_conflict_)

```
count (continued)
    BASIC_SECTOR_WORKLOAD_MEASURES (hold_pa_)
    BASIC_SECTOR_WORKLOAD_MEASURES (speed_change_pa_)
    BASIC_SECTOR_WORKLOAD_MEASURES (vector_pa_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (airspace-conflict_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (altitude_change_pa_)
    COMBINED_SECTOR_WORKLOAD_MEASURES
      (altitude_change_with_restrictions_pa_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (aver_aircraft_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (fp_conflict_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (hold_pa_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (sector_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (speed_change_pa_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (vector_pa_)

date
    CURRENT_TIME

destination
    FLIGHT_PLANS

direction
    HOLD_ON_ROUTE_PLANNED_ACTIONS (inbound_)
    HOLD_ON_ROUTE_PLANNED_ACTIONS (turn_)
    WINDS

distance
    AIRCRAFT_TRACKED_POSITION (along_route_)
    ALTITUDE_CHANGE_PLANNED_ACTIONS (base_along_route_)
    ENCOUNTERS (msep_)
    HOLD_ON_ROUTE_PLANNED_ACTIONS (leg_length_)
    PRIOR_ENCOUNTERS (msep_)
    ROUTES (ALONG_ROUTE_)
    SPEED_CHANGE_PLANNED_ACTIONS (base_along_route_)

equippage
    FLIGHT_PLANS

gradient
    CLIMB_IAS_TO_GRADIENT
    CLIMB_MACH_TO_GRADIENT
    DESCENT_IAS_TO_GRADIENT
    DESCENT_MACH_TO_GRADIENT

ias (see also "speed" and "mach")
    NOMINAL_CLIMB_SPEEDS
    NOMINAL_DESCENT_SPEEDS
```

```
id
    ALTITUDE_CHANGE_PLANNED_ACTION_ (PA_)
    ALTITUDE_RESTRICTIONS_PARAMETERS (PA_)
    BASIC_SECTOR_WORKLOAD_MEASURES (TIME_INTERVAL_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (TIME_INTERVAL_)
    E_MSAW_AREAS (volume_)
    ENCOUNTERS (SECOND_FL_)
    ENCOUNTERS (FIRST_FL_)
    ENVIRONMENTAL_CELL_CONTENTS (CELL_)
    ENVIRONMENTAL_CELL_CONTENTS (VOLUME_)
    ENVIRONMENTAL_CELLS (CELL_)
    ENVIRONMENTAL_CONFLICT (FL_)
    ENVIRONMENTAL_CONFLICT (volume_)
    FLIGHT_ID_ASSOCIATIONS (FL_)
    HOLD_ON_ROUTE_PLANNED_ACTIONS (PA_)
    MANEUVER_ENVELOPES (FL_)
    PLANNED_ACTION_DURATION (PA_)
    PLANNED_ACTIONS (PA_)
    PLANNED_ACTIONS (fl_)
    PRIOR_ENCOUNTERS (FIRST_FL_)
    PRIOR_ENCOUNTERS (SECOND_FL_)
    ROUTES (FL_)
    SECTOR_SHELVES (volume_)
    SECTORS (volume_)
    SECTORS_ENTERED (FL_)
    SPARSE_CELLS (FL_)
    SPARSE_CELLS (TREE_NODE_)
    SPECIAL_USE_AIRSPACES (volume_)
    SPEED_CHANGE_PLANNED_ACTIONS (PA_)
    SPEED_RESTRICTIONS_PARAMETERS (PA_)
    SWP_CELL (CELL_)
    SWP_CELL (x_cell_)
    SWP_CELL (y_cell_)
    TRAJECTORIES (FL_)
    VECTOR_PLANNED_ACTIONS (PA_)
    VOLUME_COORDINATES (VOLUME_)
    VOLUMES (VOLUME_)
    WINDS (WIND_CELL_)

location
    SPEED_CHANGE_PLANNED_ACTIONS (base_value_)

mach (see also "ias" and "speed")
    NOMINAL_CLIMB_SPEEDS
    NOMINAL_DESCENT_SPEEDS
```

```
measure
    BASIC_SECTOR_WORKLOAD_MEASURES (density_)
    BASIC_SECTOR_WORKLOAD_MEASURES (overall_workload_)
    BASIC_SECTOR_WORKLOAD_MEASURES (weighted_pa_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (density_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (overall_workload_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (weighted_pa_)
    WORKLOAD_THRESHOLDS (WORKLOAD_)

name
    ADAPTED_FIXES (FIX_)
    AIRCRAFT_CURRENT_CLEARANCE (FLIGHT_)
    AIRCRAFT_TRACKED_POSITION (FLIGHT_)
    AIRWAYS (AIRWAY_)
    AIRWAYS (fix_)
    E_MSAW_AREAS (E_MSAW_)
    FLIGHT_ID_ASSOCIATIONS (flight_)
    FLIGHT_PLANS (FLIGHT_)
    FLIGHT_PLANS (arrival_procedure_)
    FLIGHT_PLANS (dep_arr_procedure_)
    FLIGHT_PLANS (departure_procedure_)
    SECTOR_SHELVES (SHELF_)
    SECTORIZATION_PLAN (area_)
    SECTORIZATION_SCHEDULE (AREA_)
    SECTORS (center_)
    SECTORS (sector_)
    SPECIAL_USE_AIRSPACES (SPECIAL_USE_AIRSPACE_)

number
    AIRWAYS (VERTEX_)
    BASIC_SECTOR_WORKLOAD_MEASURES (SECTOR_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (SECTOR_)
    SECTOR_SHELVES (SECTOR_)
    SECTORIZATION_PLAN (SECTOR_)
    SECTORIZATION_PLAN (combined_sector_)
    SECTORS (SECTOR_)
    SECTORS_ENTERED (sector_)
    SWP_CELL (sector_)
    VECTOR_PLANNED_ACTIONS (VERTEX_SEQUENCE_)
    VOLUME_COORDINATES (VERTEX_)
    WORKLOAD_THRESHOLDS (SECTOR_)

origin
    FLIGHT_PLANS

qualifier
    ALTITUDE_RESTRICTIONS_PARAMETERS (rest_)
    SPEED_RESTRICTIONS_PARAMETERS (rest_)
```

```
source
    AIRCRAFT_ACCELERATION
    AIRCRAFT_LRC_SPEED
    AIRCRAFT_MAX_ENDURANCE_SPEED
    AIRCRAFT_MIN_MAX_SPEED
    CLIMB_IAS_TO_GRADIENT
    CLIMB_MACH_TO_GRADIENT
    DESCENT_IAS_TO_GRADIENT
    DESCENT_MACH_TO_GRADIENT
    NOMINAL_CLIMB_SPEEDS
    NOMINAL_DESCENT_SPEEDS
    PLANNED_ACTIONS (pa_)

speed (see also "ias" and "mach")
    AIRCRAFT_CURRENT_CLEARANCE
    AIRCRAFT_LRC_SPEED
    AIRCRAFT_MAX_ENDURANCE_SPEED
    AIRCRAFT_MIN_MAX_SPEED (max_)
    AIRCRAFT_MIN_MAX_SPEED (min_)
    CLIMB_IAS_TO_GRADIENT
    CLIMB_MACH_TO_GRADIENT
    DESCENT_IAS_TO_GRADIENT
    DESCENT_MACH_TO_GRADIENT
    FLIGHT_PLANS (approved_true_air_)
    SPEED_CHANGE_PLANNED_ACTIONS
    TRAJECTORIES (ground_)
    WINDS

string
    FLIGHT_PLANS (approved_route_)

t (see also "time")
    ALTITUDE_CHANGE_PLANNED_ACTIONS (base_)
    MANEUVER_ENVELOPES (ld_)
    MANEUVER_ENVELOPES (lu_)
    MANEUVER_ENVELOPES (rd_)
    MANEUVER_ENVELOPES (ru_)

temperature
    WINDS

time (see also "t")
    AIRCRAFT_TRACKED_POSITION
    ALTITUDE_CHANGE_PLANNED_ACTIONS (resume_climb_)
    BASIC_SECTOR_WORKLOAD_MEASURES (total_fl_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (total_fl_)
    CURRENT_TIME
    ENCOUNTERS (adv_viol_end_)
```

time (continued)
    ENCOUNTERS (ADV_VIOL_START_)
    ENCOUNTERS (display_as-advisory_)
    ENCOUNTERS (display_as_priority_)
    ENCOUNTERS (msep_)
    ENCOUNTERS (prior_viol_end_)
    ENCOUNTERS (prior_viol_start_)
    ENVIRONMENTAL_CONFLICT
    ENVIRONMENTAL_CONFLICT (display_as_advisory_)
    HOLD_ON_ROUTE_PLANNED_ACTIONS (EFC_)
    HOLD_ON_ROUTE_PLANNED_ACTIONS (leg_length_)
    MANEUVER_ENVELOPES
    PLANNED_ACTION_DURATION (pa_start_)
    PLANNED_ACTION_DURATION (pa_end_)
    PLANNED_ACTIONS (plan_)
    PRIOR_ENCOUNTERS (adv_viol_end_)
    PRIOR_ENCOUNTERS (ADV_VIOL_START_)
    PRIOR_ENCOUNTERS (display_as_advisory_)
    PRIOR_ENCOUNTERS (display_as_priority_)
    PRIOR_ENCOUNTERS (msep_)
    PRIOR_ENCOUNTERS (prior_viol_end_)
    PRIOR_ENCOUNTERS (prior_viol_start_)
    SECTORIZATION_SCHEDULE
    SECTORS_ENTERED
    SPARSE_CELLS (entry_)
    SPARSE_CELLS (exit_)
    SPECIAL_USE_AIRSPACES (start_)
    SPECIAL_USE_AIRSPACES (stop_)
    SPEED_CHANGE_PLANNED_ACTIONS (base_)
    TRAJECTORIES
    WINDS
    WORKLOAD_THRESHOLDS

type
    ADAPTED_FIXES (fix_)
    ALTITUDE_CHANGE_PLANNED_ACTIONS (base_value_)
    ALTITUDE_CHANGE_PLANNED_ACTIONS (transition_)
    CLIMB_IAS_TO_GRADIENT (gradient_)
    CLIMB_MACH_TO_GRADIENT (gradient_)
    DESCENT_IAS_TO_GRADIENT (gradient_)
    DESCENT_MACH_TO_GRADIENT (gradient_)
    FLIGHT_ID_ASSOCIATIONS (fl_id_)
    FLIGHT_PLANS (aircraft_)
    FLIGHT_PLANS (arrival_procedure_)
    FLIGHT_PLANS (dep_arr_procedure_)
    FLIGHT_PLANS (departure_procedure_)
    HOLD_ON_ROUTE_PLANNED_ACTIONS (leg_length_)
    PLANNED_ACTIONS (pa_)

```
type (continued)
    SECTORIZATION_PLAN (PLAN_)
    SECTORIZATION_SCHEDULE (plan_)
    SPECIAL_USE_AIRSPACES (airspace_)
    SPEED_CHANGE_PLANNED_ACTIONS (base_value_)
    TRAJECTORIES (cusp_)
    VOLUMES (polygon_)
    VOLUMES (volume_)

value
    COMBINED_SECTOR_WORKLOAD_MEASURES (block_density_)
    COMBINED_SECTOR_WORKLOAD_MEASURES (cell_density_)
    WORKLOAD_THRESHOLDS (threshold_)

weight
    FLIGHT_PLANS

x
    ADAPTED_FIXES
    AIRCRAFT_TRACKED_POSITION
    AIRCRAFT_TRACKED_POSITION (velocity_)
    ALTITUDE_CHANGE_PLANNED_ACTIONS (base_)
    ALTITUDE_RESTRICTIONS_PARAMETERS (rest_)
    ENCOUNTERS (f11_viol_end_)
    ENCOUNTERS (f11_viol_start_)
    ENCOUNTERS (f12_viol_end_)
    ENCOUNTERS (f12_viol_start_)
    ENVIRONMENTAL_CELLS (max_)
    ENVIRONMENTAL_CELLS (min_)
    ENVIRONMENTAL_CONFLICT
    HOLD_ON_ROUTE_PLANNED_ACTIONS (hold_fix_)
    MANEUVER_ENVELOPES (ld_)
    MANEUVER_ENVELOPES (lu_)
    MANEUVER_ENVELOPES (rd_)
    MANEUVER_ENVELOPES (ru_)
    PRIOR_ENCOUNTERS (f11_viol_end_)
    PRIOR_ENCOUNTERS (f11_viol_start_)
    PRIOR_ENCOUNTERS (f12_viol_end_)
    PRIOR_ENCOUNTERS (f12_viol_start_)
    ROUTES
    SECTORS_ENTERED
    SPEED_CHANGE_PLANNED_ACTIONS (base_)
    TRAJECTORIES
    VECTOR_PLANNED_ACTIONS
    VOLUME_COORDINATES
    WINDS (blt_)
    WINDS (flb_)
    WINDS (frb_)
```

y

ADAPTED_FIXES
AIRCRAFT_TRACKED_POSITION
AIRCRAFT_TRACKED_POSITION (velocity_)
ALTITUDE_CHANGE_PLANNED_ACTIONS (base_)
ALTITUDE_RESTRICTIONS_PARAMETERS (rest_)
ENCOUNTERS (f11_viol_end_)
ENCOUNTERS (f11_viol_start_)
ENCOUNTERS (f12_viol_end_)
ENCOUNTERS (f12_viol_start_)
ENVIRONMENTAL_CELLS (max_)
ENVIRONMENTAL_CELLS (min_)
ENVIRONMENTAL_CONFLICT
HOLD_ON_ROUTE_PLANNED_ACTIONS (hold_fix_)
MANEUVER_ENVELOPES (ld_)
MANEUVER_ENVELOPES (lu_)
MANEUVER_ENVELOPES (rd_)
MANEUVER_ENVELOPES (ru_)
PRIOR_ENCOUNTERS (f11_viol_end_)
PRIOR_ENCOUNTERS (f11_viol_start_)
PRIOR_ENCOUNTERS (f12_viol_end_)
PRIOR_ENCOUNTERS (f12_viol_start_)
ROUTES
SECTORS_ENTERED
SPEED_CHANGE_PLANNED_ACTIONS (base_)
TRAJECTORIES
VECTOR_PLANNED_ACTIONS
VOLUME_COORDINATES
WINDS (blt_)
WINDS (flb_)
WINDS (frb_)

z (see also "altitude")

AIRCRAFT_TRACKED_POSITION
AIRCRAFT_TRACKED_POSITION (velocity_)
ALTITUDE_RESTRICTIONS_PARAMETERS (rest_)
ENCOUNTERS (f11-viol_end_)
ENCOUNTERS (f11_viol_start_)
ENCOUNTERS (f12_viol_end_)
ENCOUNTERS (f12_viol_start_)
MANEUVER_ENVELOPES (ld_)
MANEUVER_ENVELOPES (lu_)
MANEUVER_ENVELOPES (rd_)
MANEUVER_ENVELOPES (ru_)
PRIOR ENCOUNTERS (f11-viol_end_)
PRIOR ENCOUNTERS (f11_viol_start_)
PRIOR ENCOUNTERS (f12_viol_end_)
PRIOR ENCOUNTERS (f12_viol_start_)

z (continued)
SECTORS_ENTERED
SPARSE_CELLS (max_)
SPARSE_CELLS (min_)
SPEED_CHANGE_PLANNED_ACTIONS (base_)
TRAJECTORIES
WINDS (blt_)
WINDS (flb_)
WINDS (frb_)

APPENDIX D

INDEX OF TABLE TYPES

APPENDIX E

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